The Electrical Industry's Weekly Magazine July 3, 1961

Electrical World

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Transmission Grid Ties N.Y. State Generation, Loads

. . . page 33

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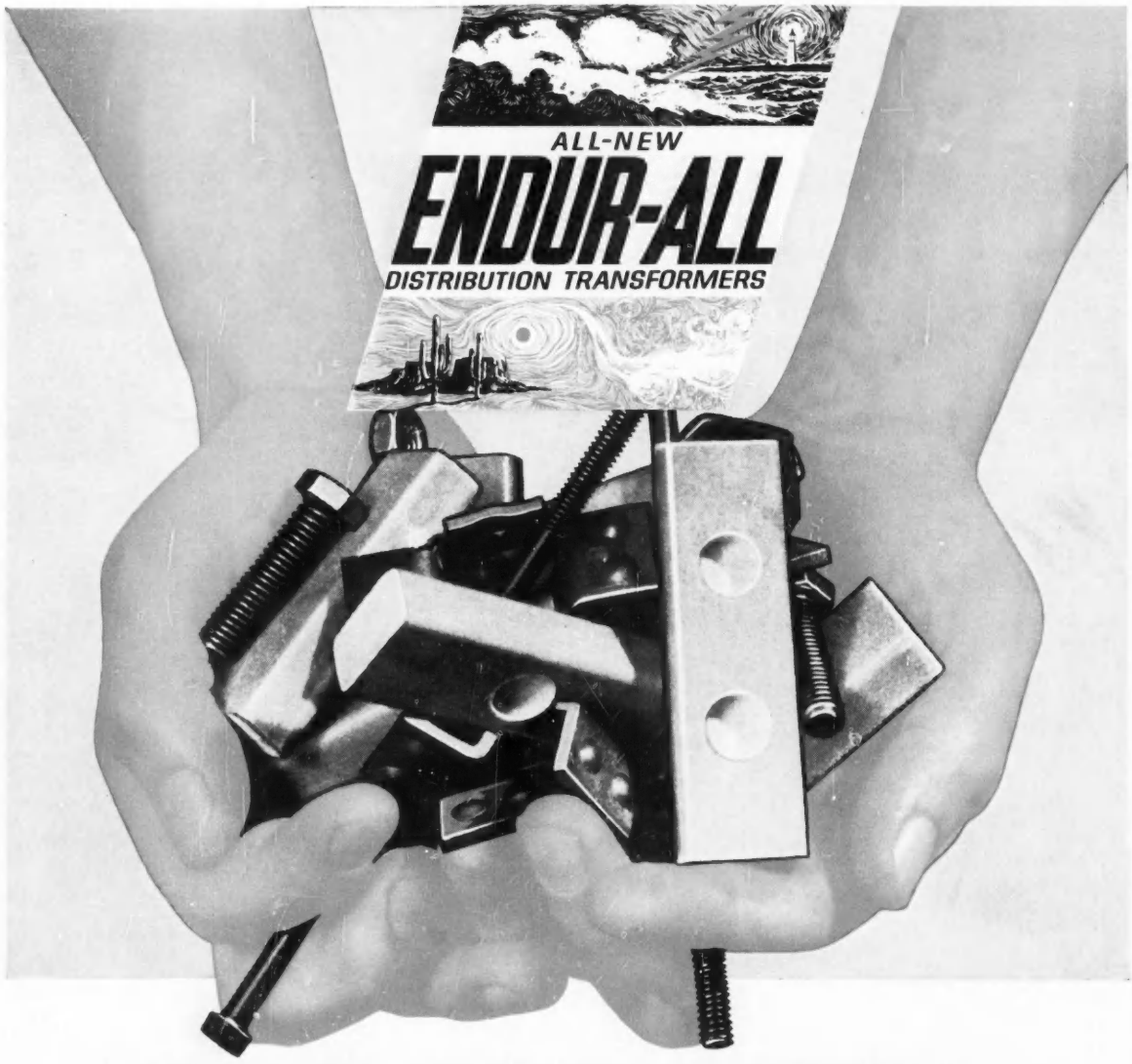

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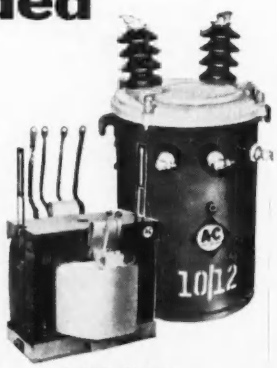

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Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

July 3, 1961
Vol. 156, No. 1

Dateline . . .

Federal Power Precedents Are in the Making

Washington, D. C.—Precedent is in the making again for federal power policies, particularly in relation to the Pacific Northwest.

National power policies, like many other matters, seem to run in periods of change and stability. The last period of radical change in power policy took place in the early "New Deal" days—strongly toward public power (TVA, REA, SEC and the present version of FPC were born in that period).

Since then, federal policies have remained fairly frozen. Few precedents have been set. President Truman's administration mostly was a "caretaker" operation for the old New Deal days. President Eisenhower's term might have set precedents moving toward more local authority over power, but a Democratic majority in Congress stifled this for six of his eight years in office—"partnership," higher REA interest rates, private co-op financing all failed to win support.

Now President Kennedy's "New Frontier" is entrenched in Washington, and policy precedents are in the making—and again toward growing federal influence over power development. Not all these possible precedents are direct attempts to change policy; some are indirect results; some even may run against the public power grain.

The Pacific Northwest is the center for most of these policy changes, as the area—rich in hydropower capacity—moves rapidly toward maximum use of its hydro potential.

Some of the potential precedents looming in the Northwest are:

• **EHV federal transmission lines between distant regions of the country,** in some cases duplicating existing power lines. The federal lines seem to be the initial step in setting up a nationwide federal transmission grid—widely espoused in earlier years by the late Leland Olds and others. "Common carrier," a term now used widely by the Kennedy Administration, has little meaning except to promote building of bigger lines.

(*Continued on page 5*)

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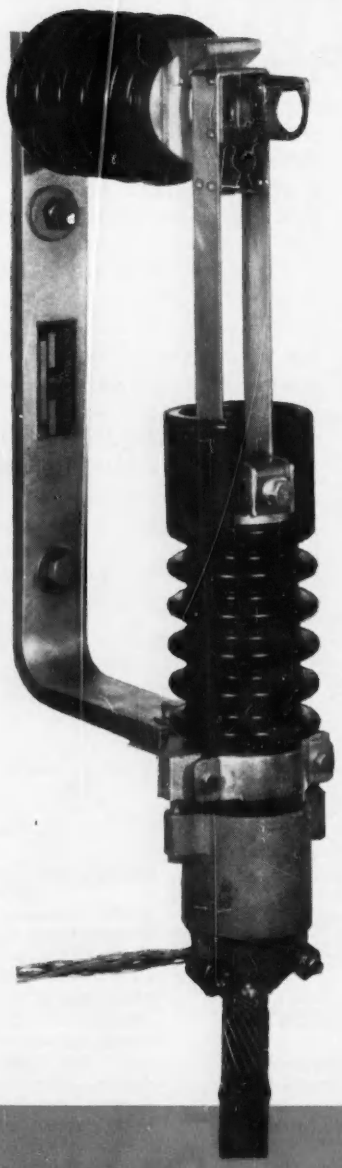

A NEW MEANS FOR TERMINATING HIGH-VOLTAGE CABLE with built-in stress cone and air-excluding sealing system. The installation is simple and rapid.

A PREFORMED STRESS CONE provides corona-free dielectric grading within the metal base and rugged porcelain housing.

UNIQUE DESIGN permits space and cost economies without reducing performance margins.

PSC COMBINATION WITH REMOVABLE BLADE SWITCH (illustrated) provides additional space economy and much-needed safety features.

FOR ADDITIONAL INFORMATION on the new Joslyn PSC Cable Terminating Equipment write or ask your Joslyn Representative for Product Information Bulletin 146.

JOSLYN COMPLETE POLE LINE EQUIPMENT

JOSLYN MFG. AND SUPPLY CO., 155 N. WACKER DRIVE, CHICAGO 6, ILLINOIS

Dateline . . .

Washington, D. C. (*Continued from page* 3)

• **Steam generation at federal power plants.** The Hanford nuclear plant (700,000 kw) would produce the first significant federal steam power outside the TVA area and the first to be marketed by the Interior Department. Although billed as peculiar to the Hanford situation, it will set a precedent possibly leading to federal "utility responsibility." Incidentally, Interior Assistant Secretary Ken Holum has said of the federal government, "We do have a responsibility" in meeting future preference customer loads.

• **Federal "headwater benefit" payments.** These benefits would be indirect results of negotiations between Bonneville and non-federal systems, leading to a coordinating agreement among all Pacific Northwest systems. Talks are aimed at: (1) getting maximum hydro utilization from present systems and dams in the Columbia Basin, and (2) fixing a legal basis for assessing benefits and charges for the three Canadian treaty dams, probably to be built on the Upper Columbia. The federal government doesn't pay now for these benefits, although non-federal systems are required to, under the Federal Power Act. Assessment and payment by all parties would seem essential in such an agreement, however.

• **Softened preference clauses, due to growing political difficulties in their use.** The late Sen Richard Neuberger (D-Ore.) came to favor statewide preference before his death, and Sen Clinton Anderson (D-N.M.) had indicated he would, if necessary, sacrifice preference in favor of building generating facilities at Hanford. Also, the Bonneville-California intertie is pushing the Administration into acceptance of a regional preference provision, giving non-preference customers in an immediate area a chance at federal power before it would be exported to preference customers outside the region.

Letters

The Score on Reduced Freight Rates

To the Editor:

Your "Dateline" column (EW, May 29, p 3) mentions that "Special railroad rates based on trainload deliveries are being tried" as one means of reducing coal hauling costs.

I have been aware for some years of the fact that solid trainload operation is considerably cheaper than single carload operation for transport of bulk commodities such as coal between fixed destinations such as mine and power plant.

I would appreciate your informing me where and, if possible, on what basis these "base trainload rates" are being tried.

H. G. Gerdes
Kaiser Engineers International
Oakland, Calif.

▶ These rates are known by several designations: contract tonnage, conditional rates, and volume rates.

Usually, contract tonnage permits lower rates if a customer agrees to ship a certain specified annual tonnage. Conditional rates usually specify that a reduced rate will apply for all shipments above a minimum amount per year. Volume rates usually specify a set amount of freight on a per day basis. Volume rates and contract rates have not completely cleared the Interstate Commerce Commission or the Supreme Court, but conditional rates have been accepted.

Generally, these rail rates have been put into effect to meet either gas and oil competition (to maintain a coal market), truck competition, or pipeline competition. Examples of these rates are: the Chesapeake & Ohio has signed a contract with Kentucky Power Co for delivery of 80% of the utility's coal needs for the Big Sandy plant when it opens next year; volume rates now exist for Niagara Mohawk's Dunkirk and Huntley plants; reduced rates on a volume basis to meet truck competition have been placed into effect for utilities on the southern coast of Lake Erie; and about 15 utilities along the Atlantic seaboard now have conditional rates. The Atlantic seaboard rates are a joint railroad operation which includes such railroads as the New York Central, the Baltimore & Ohio, and the Pennsylvania Railway.

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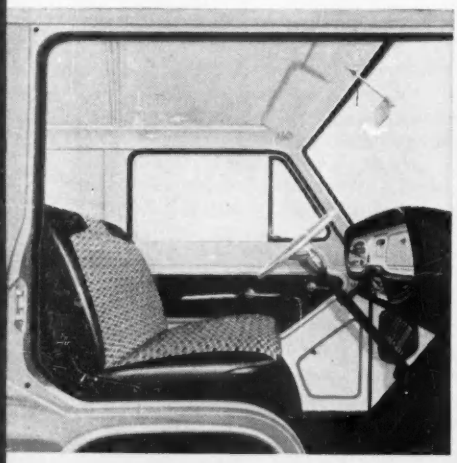
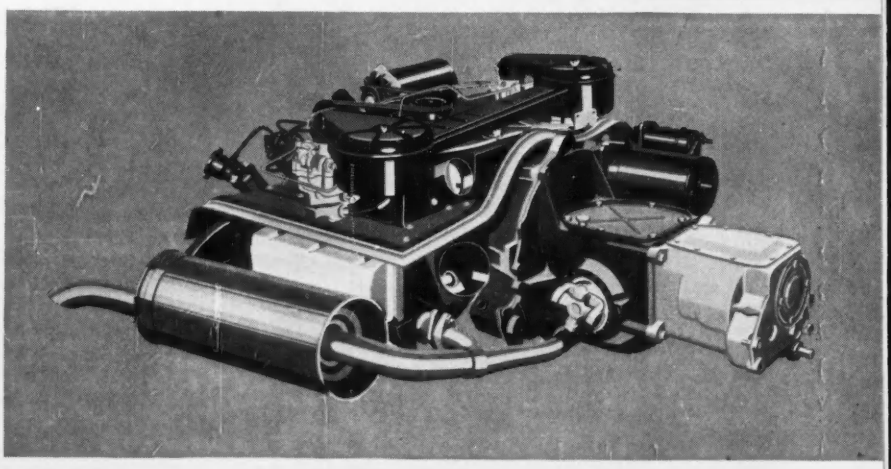
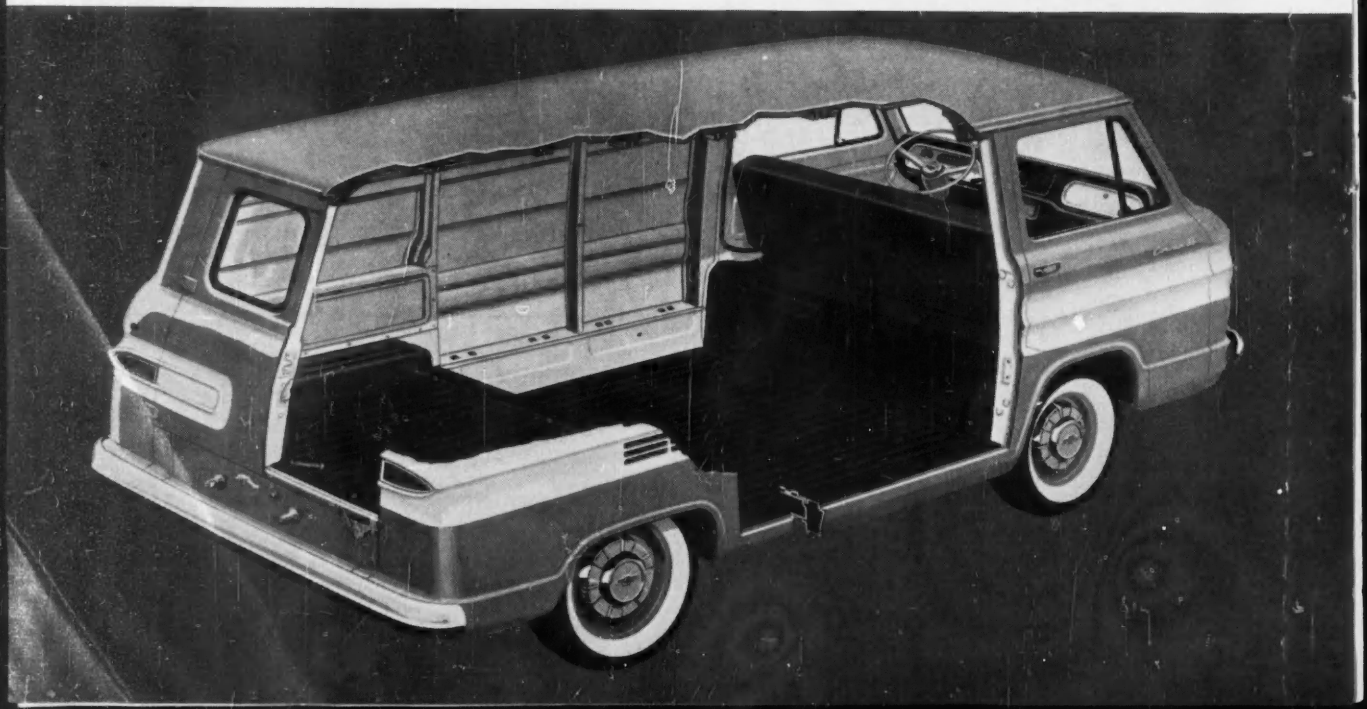






THERE'S A DOLLAR-SAVING DIFFERENCE IN CORVAIR 95!

We mean there's a whopping difference—the kind that puts a truck in a class by itself. You can see it, too, especially if you know where to look. In Corvair 95 design details, for instance—the things that tell you a truck is built with care throughout, crafted in a quality way that means more miles before trade-in and less expense along the route. We mean it's the kind of difference that will pay off in dollars every day on your job!

Power team and driver compartment—evidence of extra efficiency. Tucked neatly between the rear wheels is the most practical truck-design idea in years—the Corvair 95 *Unipack power team.* Engine, transmission and rear axle are combined in one compact, *durable* unit. Power is delivered to the rear wheels by the shortest, most efficient route. This unitized power train design (including an engine that measures only 17″ high) takes up less space—allows for more cargo area in the truck's interior. The engine itself is something new in save-as-you-go power: a tough aluminum air-cooled 6 that moves your loads briskly on a minimum of gas. Up front, the big difference in Corvair 95 design is apparent in a driver compartment that gives you bird's-eye visibility (no hood to limit vision), plenty of leg room, and a comfortable foam cushioned seat—full-width seat is optional at extra cost.

Corvan's stay-together build goes unchallenged in this field.

Unitized body construction means maximum strength with minimum weight—for bigger cargoes.

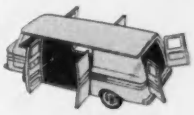
Super-rigid frame-floor assembly outperforms combination of separate frame and body floor. Eliminates a major part of a separate frame's weight.

All-steel double-walled side panels and doors strengthen the body structure. Extra toughness is engineered into a body that gives more room inside.

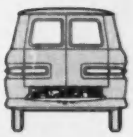
Friction-free coil springs at all four wheels assure top load-carrying capacity and *smooth* ride.

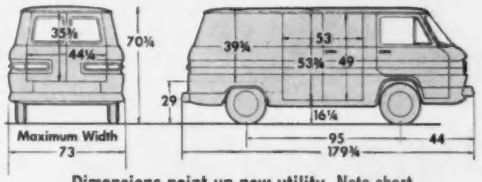
Side-loading platform is only 16¼″ off the ground—loading's never been easier, yet there's plenty of clearance below for maneuvering over rough spots.

Big cargoes are easy to load through wide side doors. Doors open so wide that you can load a 4′ x 4′ crate with ease! Right-side doors standard, left-side doors optional, extra cost.



Engine access door speeds up servicing—gives fast access to oil filler, distributor, coil, generator and oil filter.





Dimensions point up new utility. Note short wheelbase, low side and rear loading heights.

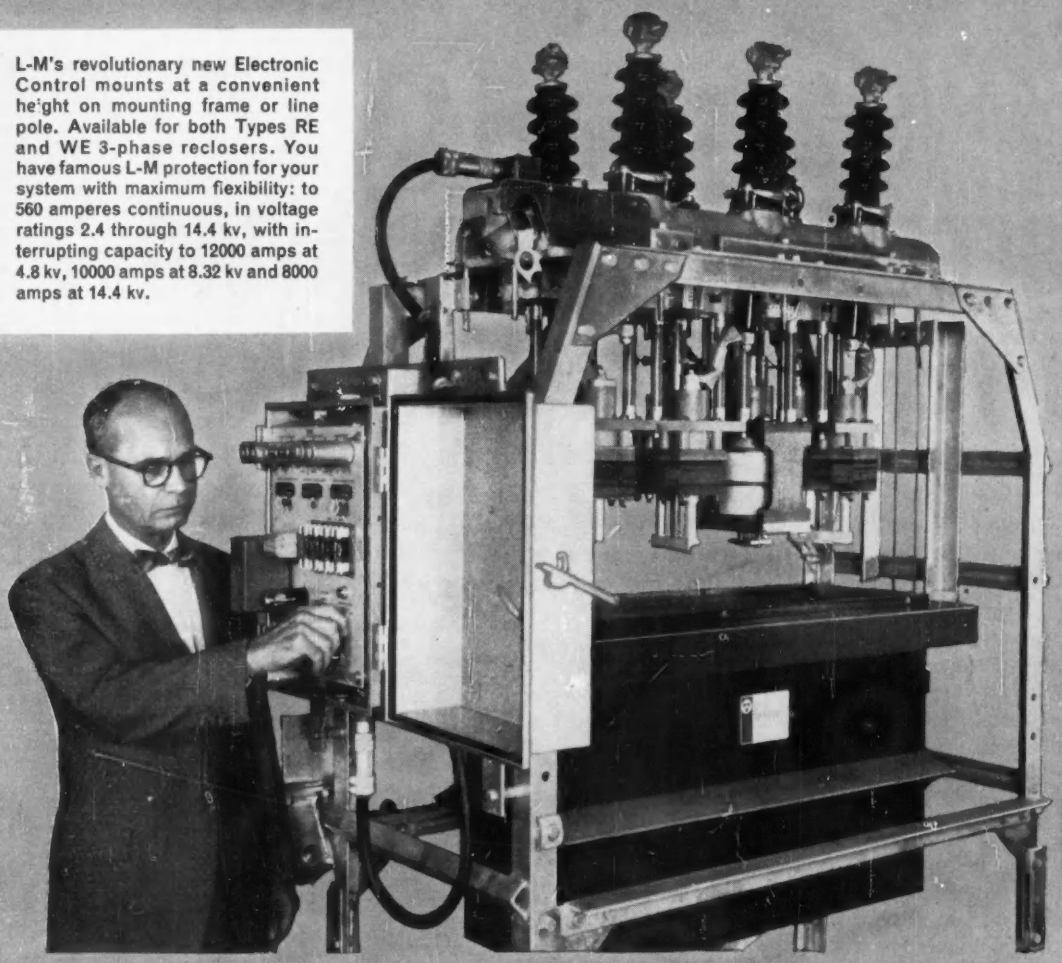
There are literally scores of reasons why no other truck of this type can do so much to put you dollars ahead. There's a cargo area that's 10 feet long . . . with balanced weight distribution that enables a Corvan to carry up to 1,700 lbs. of payload with a 4,600-lb. GVW. There's a short 95-inch wheelbase for nimble maneuvering; deep-biting traction with engine weight in the rear; handsome styling that's good for business.

That's Corvair 95's special brand of *efficiency,* ready to give you bigger profit hauling in the years ahead. See for yourself at your Chevrolet dealer's. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

1961 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

L-M's revolutionary new Electronic Control mounts at a convenient he'ght on mounting frame or line pole. Available for both Types RE and WE 3-phase reclosers. You have famous L-M protection for your system with maximum flexibility: to 560 amperes continuous, in voltage ratings 2.4 through 14.4 kv, with interrupting capacity to 12000 amps at 4.8 kv, 10000 amps at 8.32 kv and 8000 amps at 14.4 kv.

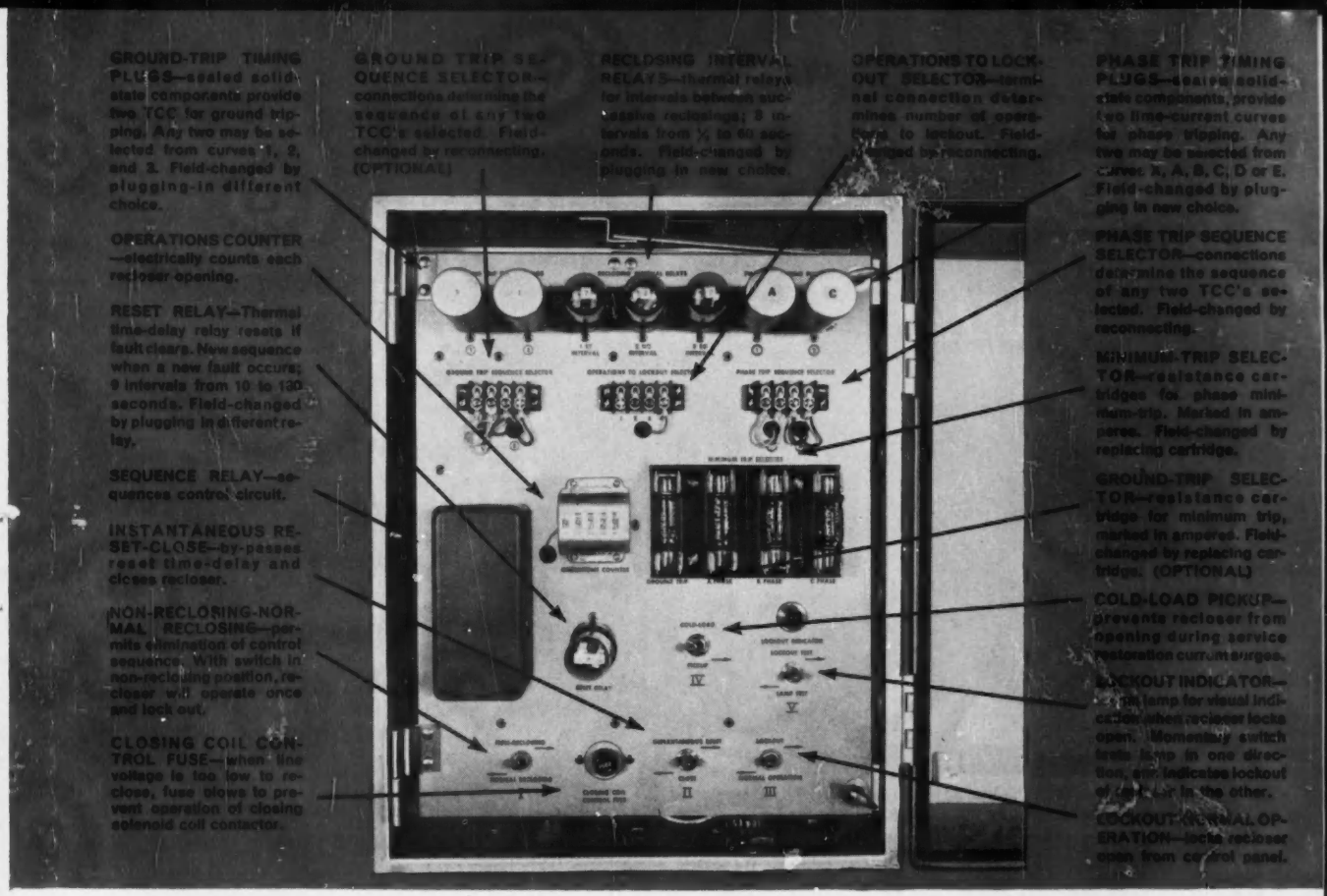


Outstanding Features of L-M Reclosers

- Lowest possible cost—no other device can match L-M's recloser protection for the same money.
- Simple installation—when controls are adjusted you just connect circuit conductors to bushing terminals and recloser is in operation.
- Wholly-contained—requires no auxiliary power supplies or relays whether installed in substation or on pole top.

Now New L-M Electronic Control Adds:

- Greater control flexibility—minimum trip current, number of operations to lockout, number of fast and retarded operations and time-current characteristics field-changed without untanking or interrupting service.
- Greater Application Flexibility—the basic Electronic control is complete with all control possibilities built in except optional ground trip. All possible protection is contained in one unit.
- Complete test-ability—control may be tested with 120 volts AC with very low current.
- Ground Level Operation—Control panel may be mounted independent of recloser.
- Simplified Coordination—L-M Electronic control offers special operating characteristics apart from time-current characteristics presently offered.


GROUND-TRIP TIMING PLUGS—sealed solid-state components provide two TCC for ground tripping. Any two may be selected from curves 1, 2, and 3. Field-changed by plugging-in different choice.
OPERATIONS COUNTER—electrically counts each recloser opening.
RESET RELAY—Thermal time-delay relay resets if fault clears. New sequence when a new fault occurs; 9 intervals from 10 to 180 seconds. Field-changed by plugging in different relay.
SEQUENCE RELAY—sequences control circuit.
INSTANTANEOUS RESET-CLOSE—by-passes reset time-delay and closes recloser.
NON-RECLOSING-NORMAL RECLOSING—permits elimination of control sequence. With switch in non-reclosing position, recloser will operate once and lock out.
CLOSING COIL CONTROL FUSE—when line voltage is too low to re-close, fuse blows to prevent operation of closing solenoid coil contactor.
GROUND TRIP SEQUENCE SELECTOR—connections determine the sequence of any two TCC's selected. Field-changed by reconnecting. (OPTIONAL)
RECLOSING INTERVAL RELAYS—thermal relays for intervals between successive reclosings; 3 intervals from ½ to 60 seconds. Field-changed by plugging in new choice.
OPERATIONS TO LOCK-OUT SELECTOR—terminal connection determines number of operations to lockout. Field-changed by reconnecting.
PHASE TRIP TIMING PLUGS—sealed solid-state components provide two time-current curves for phase tripping. Any two may be selected from curves X, A, B, C, D or E. Field-changed by plugging in new choice.
PHASE TRIP SEQUENCE SELECTOR—connections determine the sequence of any two TCC's selected. Field-changed by reconnecting.
MINIMUM-TRIP SELECTOR—resistance cartridges for phase minimum-trip. Marked in amperes. Field-changed by replacing cartridge.
GROUND-TRIP SELECTOR—resistance cartridge for minimum trip, marked in amperes. Field-changed by replacing cartridge. (OPTIONAL)
COLD-LOAD PICKUP—prevents recloser from opening during service restoration current surges.
LOCKOUT INDICATOR—lamp for visual indication when recloser locks open. Momentary switch tests lamp in one direction, and indicates lockout of control in the other.
LOCKOUT-NORMAL OPERATION—locks recloser open from control panel.

L-M's New Electronic Control Provides Greater Flexibility For Reclosers

Relay, System Protection and Substation Engineers will find that the new Type RE and WE Reclosers offer the ultimate in coordinated system protection.

by **N. K. DELANEY**
Product Manager,
Switchgear and Capacitors
Line Material Industries

Oil Circuit Reclosers as developed by Line Material some years ago have been universally accepted as tremendously efficient, cost-saving protection for distribution lines and substations.

One reason for L-M's outstanding leadership in reclosers has been the L-M-developed hydraulic control, which is extremely dependable, and well accepted.

Today Line Material announces another revolutionary new engineering development—the L-M *Electronic* Control.

The *Electronic* control consists of a solid-state transistorized sensing and control device: time-delay relays for resetting and reclosing; provisions for ground current tripping; test and control switches; and plug-in components to provide for changing time-current curves and sequences without service interruptions. The L-M Electronic control provides greater flexibility, greater accessibility, and a wider choice of time-current curves than have been available even with L-M's outstanding hydraulic control.

Now Get Electronic Coordination

Get complete details on this outstanding improvement by Line Material in automatic line protection. Ask the L-M Field Engineer for Product Information Bulletin CR1WE, and ideas on how you can take advantage of this remarkable new development in oil circuit reclosers. Call the nearest L-M office; or phone or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.

LINE MATERIAL® Industries

484

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Reclosers, Sectionalizers, and Oil Switches

McGRAW EDISON

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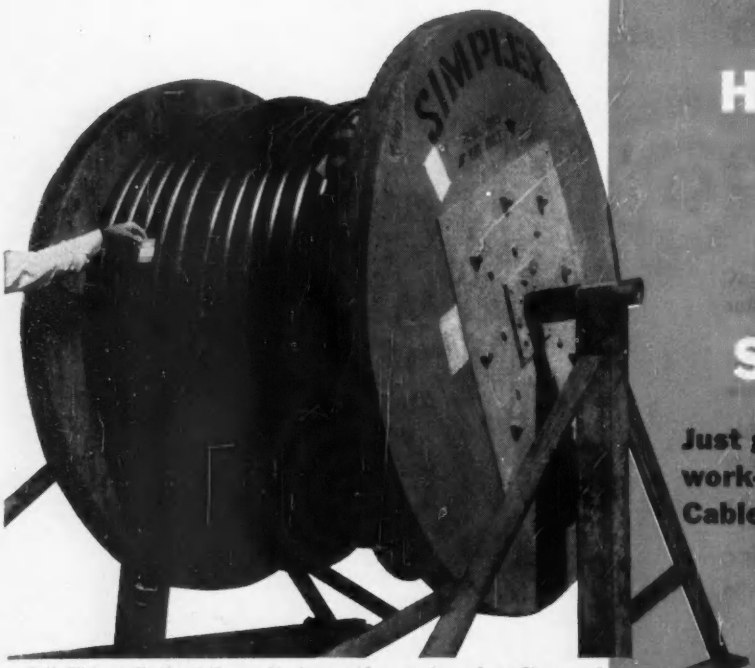

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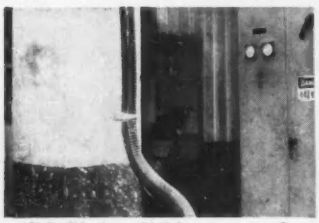

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C-L-X is easily trained anywhere, in continuous, long-length runs.

C-L-X installs without the need for benders, sand, elbows, or similar fittings.

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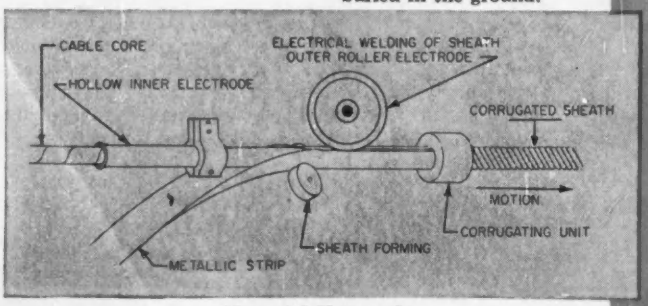

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You'll see how easily this packaged *combination* of cable and pliable, impervious metallic sheath installs. You'll see why it cuts installation cost to a fraction of that required for conventional cable and duct. Then *find out* how much money today's easiest-to-install cable system can save you.

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Electrical World

JULY 3, 1961
Vol. 156, No. 1

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PACKAGED STRUCTURES economically speed construction of Con Edison's 138-kv Ravenswood switching station 54

NEXT WEEK

SMALL COMPUTER proves to be a valuable tool for engineers.

The Electrical Week

LATE NEWS ▶ **One of the world's largest atomic power plants** will be built by Pacific Gas & Electric Co at Bodega Bay, 50 miles north of San Francisco. The plant will have a capacity of 325 Mw gross and 313 Mw net, and a thermal efficiency of 32.5%. PG&E estimates that the cost of electricity at the generator bus bar will be 5.62 mills per kwhr on the first core. Reactor, turbine-generator and all major electrical apparatus will be supplied by General Electric. Total cost of the plant, including switching station and voltage step-up transformers, will be about $61 million. The BW reactor, with forced circulation and internal steam separation, will provide saturated steam at 1,000 psi, 544F.

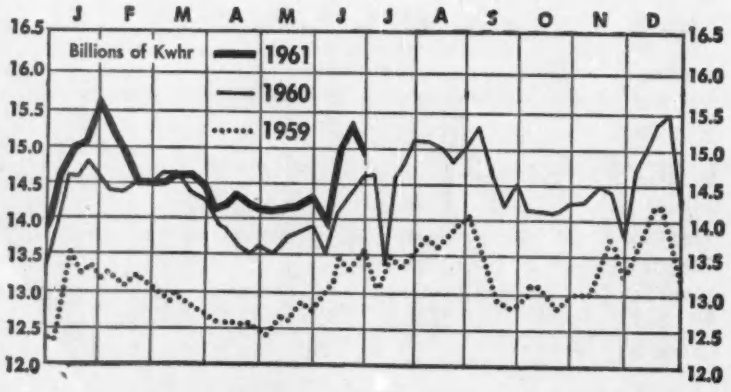
In a surprise announcement last week, Jerome Kuykendall said he will step down as FPC chairman Sept 1. This makes room for Joseph Swidler, President Kennedy's choice for the job. Kuykendall's statement came immediately after Swidler and Howard Morgan were sworn in as commission members. Kuykendall said he will probably resign from the commission before expiration of his term June 22, 1962.

Los Angeles Dept of Water & Power files a proposal with FPC to build 2,000-Mw Marble Canyon—Kanab Creek project on the Colorado River. Cost would be about $1-billion. The city suggests in its application that FPC recommend federal sponsorship, with contracting agencies repaying all costs to the government. The new application would displace one made by Arizona for the Marble Canyon site, but does not affect an earlier LADW&P application for the Bridge Canyon site. Marble Canyon is about 200 miles upstream from Hoover Dam. Planned in the project is a 43-mile tunnel from a small power plant at Marble Canyon to a gigantic underground plant at Kanab Creek. Beside Los Angeles, power would go to Arizona, Burbank, Glendale, Pasadena, and the Metropolitan Water District.

Yankee Atomic Electric's nuclear power plant goes into regular commercial operation after receiving AEC permission for full-scale operation at 485 tMw. Expected output is 140-150 Mw. Final capital requirements for Yankee are about $43,700,000, about $13-million below earlier estimates. Breakdown of the final figure shows $38.5-million for plant and land (or $270-280 per kw); $3-million for the first reactor core, and $2-million for organization, administration and miscellaneous costs.

General Electric, Westinghouse, and Allis-Chalmers ask the Philadelphia District Court to dismiss the government's first damage suit. In effect, companies deny that government or TVA suffered damages from antitrust violations.

WEEKLY POWER OUTPUT—Up 1.8% (Week ending June 24), Kwhr 14,870,000,000



Percent Change From Previous Year

	June 10	June 17	June 24
Total U. S.	+ 6.1	+ 6.3	+ 1.8
New Eng.	+ 9.2	+ 6.8	+ 7.2
Mid. Atlan. ...	+ 7.7	+ 8.0	+ 4.3
Cent. Indust. ..	+ 4.0	+ 5.9	+ 2.0
West Cent. ...	+ 7.9	+10.4	+ 2.6
Southeast	+ 8.9	+ 6.2	+ 0.6
South Cent. ...	+ 2.1	+ 2.4	−14.1
Rocky Mount. .	+ 3.1	+ 7.6	+11.1
Pacific			
NW	+ 6.7	+ 2.1	+ 3.2
SW	+ 4.6	+ 7.8	+10.9

Seasonally Adjusted Index 279

Week Ago 293 Year Ago 275

Source: Edison Electric Institute

WHAT NEXT FOR NEMA 'STATEMENT OF PRINCIPLES'?

Now that a "Statement of Principles" has been adopted by the National Electrical Manufacturers Assn (see full statement on following page), the question being asked is, what happens next? Significantly, the NEMA committee formed to hammer out this ethical practices code has not been dissolved. Its next job is to determine "what, if any, implementation will be done."

Evidently, NEMA recognizes that there is a difference between issuing such a code and making it meaningful. By its action of keeping the committee working, it is hoping to achieve the latter. Whether or not the committee is successful is another matter, but in the interim, NEMA has sent out to its member companies the Statement of Principles "which are suggested as sound guideposts for observance by individual companies." And NEMA has asked to be notified should any member company take formal action concerning the code. But as of now, membership in NEMA is not predicated upon acceptance and support of the principles.

Among the problems facing the NEMA committee in determining "implementation" of the code is the fact that NEMA, by tradition, has been an entirely voluntary organization. Even the important work of determining technical standards for the industry is voluntary. Member companies do not have to adopt NEMA standards to their products. So creation of enforcement machinery for ethical standards would mean a radical change in the nature of NEMA.

In addition, NEMA is a diverse organization serving, in effect, several distinct industries ranging from the consumer products industry to the heavy utility equipment industry. A standard of conduct acceptable in selling one product would not necessarily be appropriate in selling other products. How would one differentiate between them in enforcing the code?

Finally, if there were an infraction of the code, who specifically would be the police officer and judge, and who would be the accused—the individual, the section, the department, the division, the company as a whole? These are questions the committee may consider as it decides how far along the road of "implementation" it wants to travel.

Nevertheless, American industry in general appears to feel a need for a code of ethics with teeth in it. This point is highlighted in a thought-provoking article appearing in the July-August issue of the *Harvard Business Review* titled "How Ethical are Businessmen?" The author sent out questionnaires to 5,000 HBR readers, of whom 1,700 replied. One of the questions asked was whether they would favor a code for their particular industry. Half said they favored the idea "strongly" and only one in ten was opposed to the idea.

"But," according to the article, "this code must have 'teeth,' be capable of enforcement, and embody specific guides for conduct if it is to do the job." And only one in ten thought that the code would be easy to enforce.

Among the things the majority of executives from all of industry thought the code would do would be to: raise the ethical level of the industry; help executives by defining clearly the limits of acceptable conduct; serve as useful aid when executives wanted to refuse an unethical request impersonally. But the executives split about evenly on whether the code would reduce sharp practices in situations of severe competition, and on whether they thought people would violate the code when detection could be avoided.

On the question of who would enforce the code, 40% voted for self-enforcement,

i.e., the management of each company; 28% thought a group of executives selected from various companies within the industry should do it; another 28% thought these last executives should be aided by members of the community outside the industry; and 4% favored a government agency doing the job.

NEMA 'Statement of Principles'

PREAMBLE: *It is the responsibility and privilege of the members of the business community, as it is of all citizens, to observe the laws of the land. While all men, and all organizations, have a right to petition the Congress for a change in the laws, no man, and no organization, has a right to substitute individual judgments for those principles of behavior which are to be found in the law. Any other course can lead only to a collapse of order and to a deterioration of that system of government by law which is the foundation-stone of the United States.*

Unless the business community recognizes and accepts that responsibility and that privilege, a written code of ethics or statement of principles is of no more value than a scrap of paper.

Recognition and acceptance of the antitrust laws are of particular importance to the community of businessmen and industries, for in those laws is to be found the charter of free enterprise. Those laws are intended to provide the basis for the right of self-regulation by means of free and open competition. Their violation may undermine the economic system which our corporate society has struggled to protect against the encroachments of imposed regulation.

It has not been and is not the function of this Association to concern itself with the pricing of its members' products. Such a course might, in itself, constitute a violation of the antitrust laws.

The principles suggested herein are sound guideposts for observance by individual companies.

STATEMENT OF PRINCIPLES: *It is the obligation of each business enterprise in the electrical manufacturing industry:*

(1) *To design and manufacture good products and to market them at fair prices commensurate with the quality and values offered.*

(2) *To create new products and improve existing products in order to provide better values for customers and the nation's changing needs.*

(3) *To present fairly the quality, performance characteristics, and other values of its products.*

(4) *To jealously guard its freedom and independence in marketing and pricing its products and to take care to see that it does not abdicate its authority and responsibility to any competitor; and to accept and support the principle that competition, and the survival of the free enterprise system, presupposes the free and competitive pricing of goods and commodities.*

(5) *To determine independently the prices to be charged for its products, and all terms and conditions of sale. Any agreement or understanding among competitors, whether oral or written, concerning their prices or price policies or terms of sale, is a violation of law, violation of this Statement of Principles, and an act of business immorality. The single exception is a good faith negotiation for an agreement of purchase or sale.*

(6) *To gather competitive and market information necessary to the intelligent conduct of a business enterprise only through legal and proper channels.*

(7) *To accept as a function and responsibility of management the education of itself and its employees with respect to the antitrust laws and to take such steps as may be appropriate in each individual case to ensure compliance with those laws at all levels and to promote an awareness of the responsibilities which corporations have as citizens.*

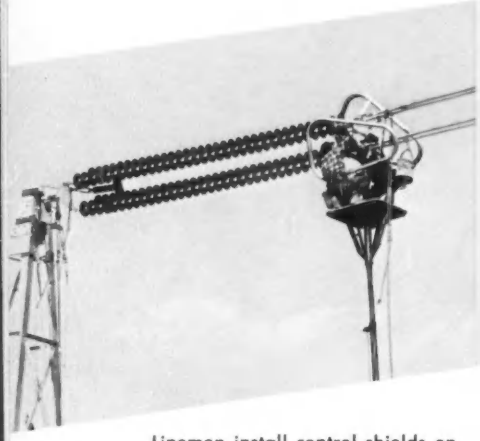
going up....to 750-kv

10093-H

Apple Grove

O-B spacers are installed on four-conductor bundle as crew at the tower works on suspension assembly.

AEP experimental line uses suspension assemblies and hardware designed by Ohio Brass



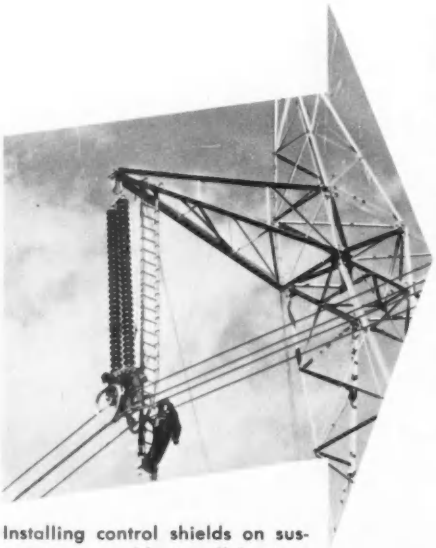
Linemen install control shields on quadruple-string 34-unit deadend assemblies.

At Apple Grove, West Virginia, new transmission structures tower over the muddy banks of the Ohio River - - landmarks of a new achievement in Extra High Voltage transmission.

Here, some 200 miles downstream from an earlier test site - - the now-famous Tidd project at Brilliant, Ohio - - American Electric Power Service Corporation and cooperating manufacturers are probing the frontiers of transmission at three-quarters of a million volts.

Ohio Brass, a participant in the earlier project, is again privileged to participate - - contributing suspension and deadend assemblies (including insulators, hardware, and control shields) and all bundle spacers used throughout lines and station.

For more detailed information on the advanced assemblies supplied to Apple Grove, send for special issue of O-B Hi-Tension News (Publication No. 6232-H).



Installing control shields on suspension assembly. Parallel strings are used on outside phases, V-string on center phase.

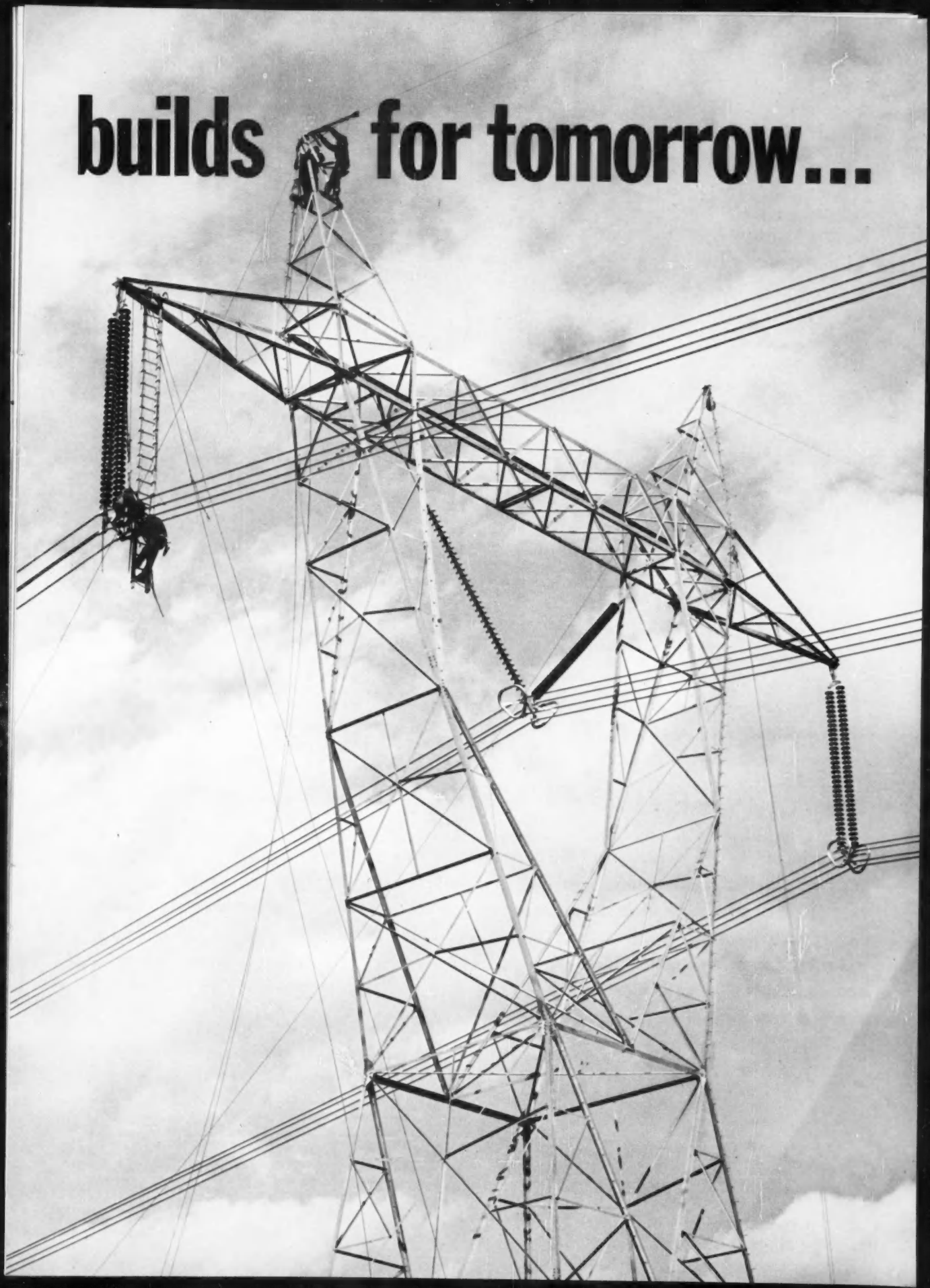
OHIO BRASS COMPANY, MANSFIELD, OHIO

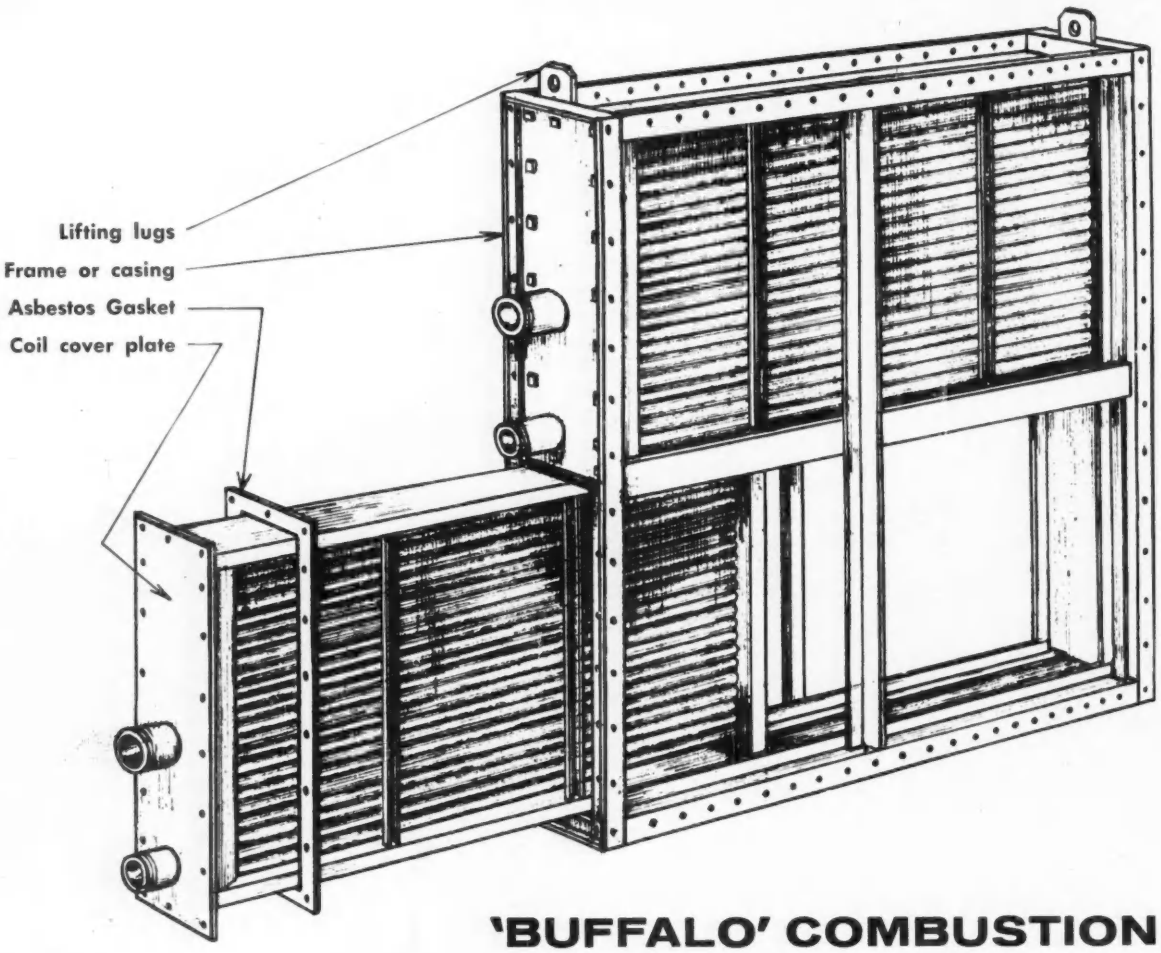
Ohio Brass

HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10086-H


builds for tomorrow...



'BUFFALO' COMBUSTION AIR HEATER PACKAGES

cost less to install and maintain!

Expensive on-the-job fabrication of coil casing and frame is eliminated when you use factory assembled 'Buffalo' combustion air heater packages. Aerofin heavy-duty steam or hot water heating coils of tapered fin design give maximum heat transfer and low air-side static loss. Heater casing of heavy structural steel prevents binding when coils are removed and inserted. The removable core cover plate, with gasket, is bolted to the casing or frame to provide a gas-tight fit at high static pressures. For low cost, easy maintenance combustion air heaters, contact your resident Buffalo Representative or write for Bulletin FD 800.

"Buffalo"

AIR HANDLING DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

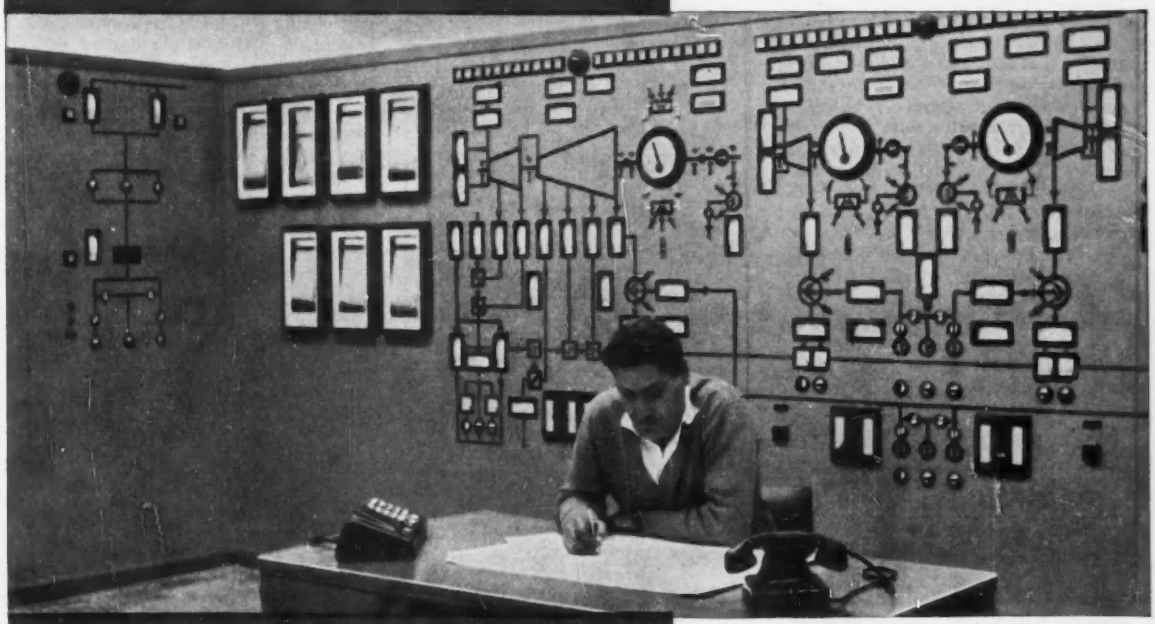
'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

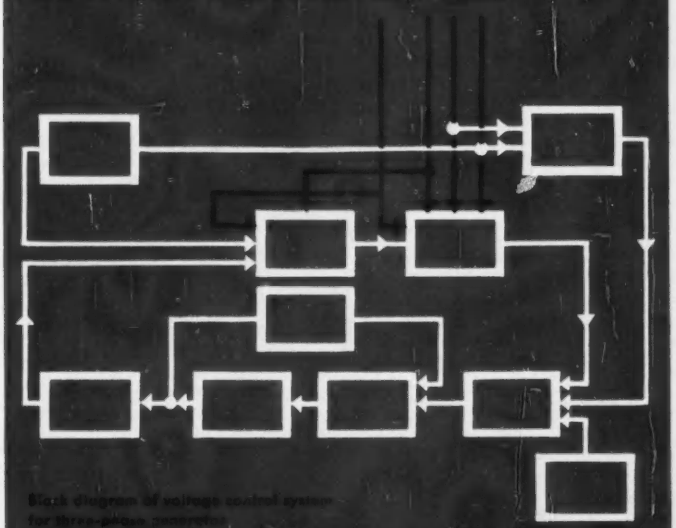
'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

MEASURING REGULATION CONTROL



View of AEG thermal control board in a new steam power station



Block diagram of voltage control system for three-phase generator

If its Automation - consult

- Measuring instruments
- Precision instrument equipment
- Indicating instruments and recorders
- Electricity meters
- Machine-tool control equipment
- Remote control systems
- Photo-electric elements
- Industrial tubes
- Reactive power limiters
- Voltage regulators
- Temperature controllers
- 'Logistat' Unit control system

AEG

8824 A ●

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

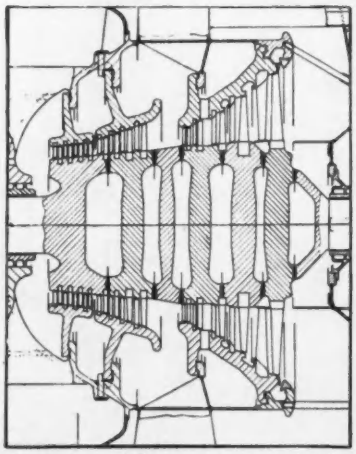
Welded sectional rotors for steam turbines

By N. K. Halsteen, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

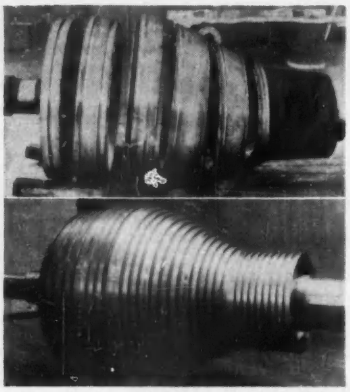
The manufacture of large, solid, one-piece rotors presents problems in detection and inspection of flaws, often resulting in the difficult choice of scrapping an expensive forging or completing the rotor with a "patch" or with an internal flaw whose effect in operation cannot be predicted with certainty. In use, the mass of a solid rotor also causes difficulty in maintaining tight shrink fits for the wheels and prevents uniform heat distribution for short start-up or shut-down schedules.

To avoid these difficulties, Brown Boveri developed a rotor made of forged discs and hollow, bell-shaped end sections welded together at the rims, forming a light, strong, rigid unit.



Cross-section of low-pressure stage showing welded segments of rotor shaft.

How Brown Boveri sectional rotors are made



Above: Sections of shaft ready for welding.

Below: The shaft after welding, heat-treatment and machining.

The rotor is assembled vertically on a turntable, the sections being centered by spigots. As the workpiece rotates past welding heads, the butting surfaces are welded. Welds are made at several points around the section at the same time—to prevent distortion. The welding is done automatically by the tungsten inert-gas process . . . providing homogeneous welds free of slag.

After a few layers of weld, the root is checked with gamma rays. If approved, the welding is completed.

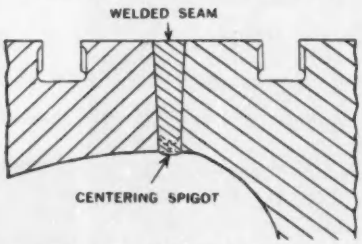
After a final ultrasonic test, the welded area is given stress-relief heat treatment, with the rotor in vertical position. Machined rotors are tested at 40% overspeed before blading . . . also balanced statically and dynamically after blading.

Advantages of sectional rotors

Because of the relatively small size of each section, forging conditions meet ideal metallurgical requirements. Inspection can be complete. Doubtful sections are scrapped without any attempt at "patching." Possible asymmetries resulting from forging are cancelled by the chance disposition of individual sections.

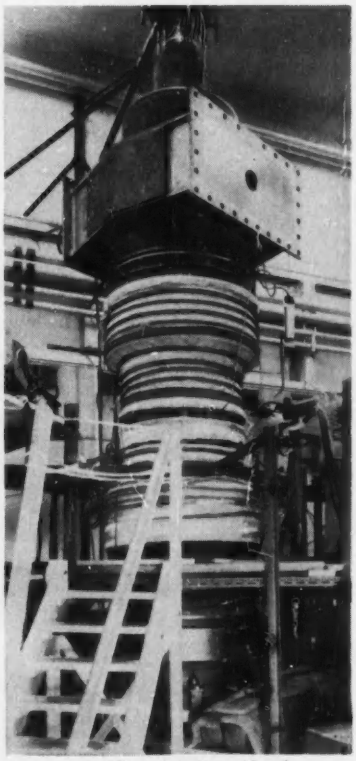
The stress-relieving procedure practically eliminates asymmetrical stresses.

The low mass of the rotor results in a favorable mass ratio between rotor and casing . . . with far less critical expansion differentials during sudden load changes or short start-up and shut-down schedules.



Cross-section of weld seam. Note uniform thickness of rims at weld — for minimum thermal stresses.

As evidence of its sound engineering, the Brown Boveri sectional rotor design has been used for over 30 years in several thousand rotors—and without a single explosion or other serious rotor failure.



Automatic welding of sections. Also shown are insulating blanket and induction heating cable for pre-heating before welding and stress-relief treatment after welding.

Other features of Brown Boveri steam turbines: an all-hydraulic governing system without rods, levers or mechanical joints subject to wear and resulting inaccuracies . . . and an unequalled reliability of service illustrated by many Brown Boveri turbines built 40 to 45 years ago and still in continuous operation.

BROWN BOVERI Brown Boveri Corp., Dept. EW7, 19 Rector Street, New York 6, N.Y. Agents in 27 U.S. cities

Look at the many different

POWER MEASURING INSTRUMENTS

Sierra offers you now

Model 160 50-ohm Coaxial Loads

Now including Models operating to 11 KMC, Sierra 160 Series low VSWR terminations may be used when stable 50 ohm loads are required. Featuring rugged design, high stability at full rated power, the loads have a typical VSWR of 1.2. All models are air-cooled and complete shielding insures personnel safety. Models with power capacities of 1, 5, and 20 watts are available with N, C and BNC connectors. 100 and 500 watt models are provided with Type N connectors. $25.00 to $200.00.

Model 185A Average-Reading Termination Wattmeters

Sierra 185A series are particularly useful in terminating rf coaxial transmission systems, measuring average powers between 20 and 1,000 MC, and as dummy loads for testing and adjusting CW and FM transmitters and oscillators. Two models with maximum power dissipation of 100 and 500 watts, and power ranges of 0 to 30/100 and 0 to 150/500 watts, respectively. Accuracy is ± 5% and VSWR is 1.2. Female Type N connectors. 185A-100FN, $260.00; 185A-500 FN, $375.00.

Model 164A Average Power Monitors

Sierra 164A Series Bi-Directional Power Monitors are now available with plug-ins down to 2 MC. Four plug-ins provide full scale ranges of 1, 5, 10 and 50 watts through frequencies 25 to 1000 MC. Two medium-power units provide full scale ranges 10, 50, 100 and 500 watts, 25 to 1000 MC. Three high-power units provide full scale ranges of 50, 100, 500, 1000 watts, 2 through 470 MC. Model 164 is now available with Type N, C, HN, UHF and LC connectors. Model 164, $115.00; plug-ins, $75.00 to $170.00.

Model 194A-A Bi-Directional Peak Power Monitor

Covering the range 200 to 1,215 MC, Sierra 194A-A Peak Power Monitor offers two important, time-saving features—peak power is read directly without computation and a reversible directional coupler permits incident or reflected power readings simply by turning one knob. Peak powers to 30 Kw are covered in 4 ranges. Measurement accuracy is ± 10% full scale at pulse widths down to 0.1 μsec or repetition rates as low as 10 pps. Minimum duty cycle 0.04% for specified accuracy. $780.

Data and prices subject to change without notice. Prices f. o. b. factory.

sierra

For complete details, see your Sierra Representative or write direct.

SIERRA ELECTRONIC CORPORATION

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6561W BOHANNON DRIVE • DAvenport 6-2060 • MENLO PARK, CALIF., U.S.A.

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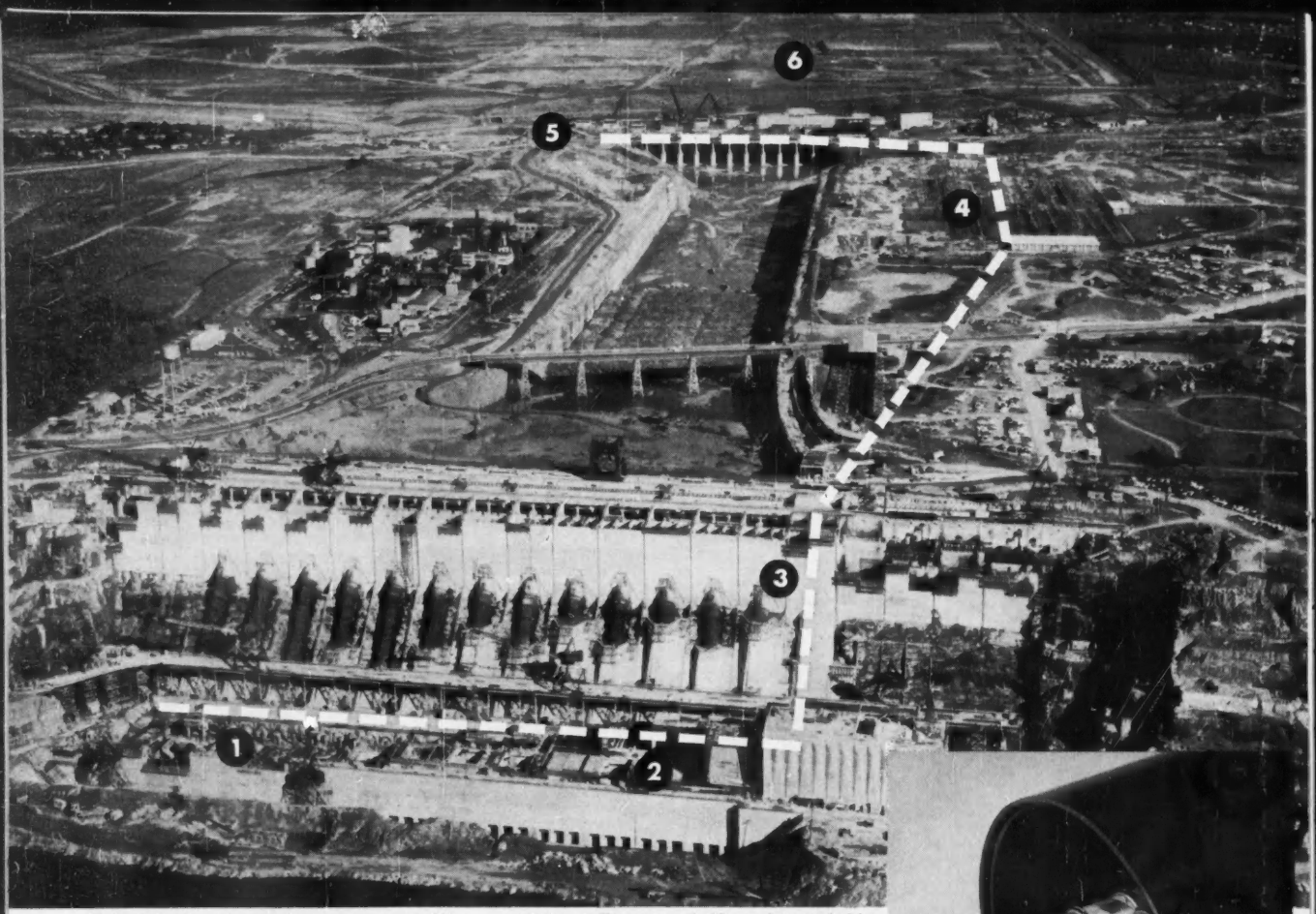
Export: Frazar & Hansen, Ltd., San Francisco, California.

6561R



This photo shows how various components of the Niagara Power Project are electrically interconnected by nineteen 115kv and 230kv Oilostatic circuits enclosed in 8⅝" O.D. pipe and installed in underground tunnels. From the Robert Moses Niagara Power Plant in the foreground (height 340 feet above the level of the Niagara River), six 230kv (1) and seven 115kv Oilostatic circuits (2) transmit power from generators up a 45°-incline power tunnel (3) to the switchyard (4). Two other 115kv circuits tie the 115kv bus to the 230kv bus through auto-transformers. The remaining four 230kv circuits connect the motor-generator units at the reservoir plant (5) to the switchyard. The reservoir (6) receives and ultimately discharges water through the motor-generator units. Not shown are two water conduits which carry water from the intake structure above Niagara Falls to the open canal between the power plants.

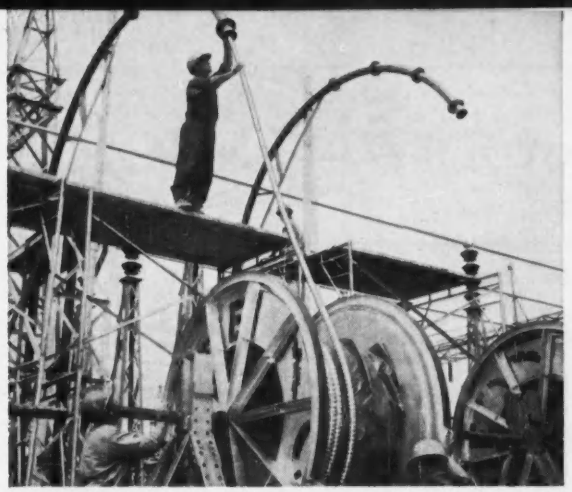
Cross-section of 115kv Oilostatic circuit in 8⅝" O.D. steel pipe. This 3-phase 1750 MCM circuit carries the entire output of one 167,000kva generator.

Niagara Power Project chooses **Okonite Oilostatic® Cable** to carry a giant power load

At one of the world's largest power projects—the New York State Power Authority's 2,470,000-kva Niagara Power Project—60,000 feet of Okonite Oilostatic cable are helping to solve some giant power transmission problems.

A total of nineteen 115kv and 230kv Oilostatic circuits tie together the various components of this $720,000,000 complex. These include: the Robert Moses Niagara Power Plant . . . the Reservoir Pump Generating Plant which alternately fills and receives water from a storage reservoir . . . two conduits to carry water from an intake structure above Niagara Falls . . . and a 115kv-230kv-345kv switchyard.

Why was Okonite Oilostatic Cable chosen to carry power from this giant project? One reason was the New York State Power Authority's desire to combine sound engineering practice with an architecturally appropriate appearance. Careful preliminary



Installing 115kv Oilostatic cables for auto-transformer circuits, workmen use large radius tube for feeding cable into riser pipes.

studies indicated Oilostatic was well suited to solve the project's problems involving congestion (which made overhead constructions impractical), appearance, maintenance and reliability.

This project presented several unique design and installation techniques which were studied and solved by the consulting firm of Uhl, Hall and Rich, working with the Okonite Engineering staff. All Oilostatic circuits in 8⅝" O.D. steel pipe were mounted in underground tunnels, installed prestressed to a length equivalent to a temperature of 70°F. The thirteen circuits at the Robert Moses Niagara Power Plant drop a vertical distance of 250 feet on a 45° angle. Standard Oilostatic cable construction was used for this unusual situation.

Four 230kv circuits from the Reservoir Pump Generating Plant to the switchyard cross an open water canal on a specially designed bridge. The Oilostatic systems are supported on roller type hangers allowing the bridge and cable circuits to expand independently. For the first time in the United States condenser type potheads were used to terminate the 230kv circuits. Except for these potheads, other material used on the project—including cable, pipe, oil, cable joints and pumping plants—are standard Okonite equipment.

This is the kind of problem-solving performance for which Okonite has long been noted. It's just one more example of Okonite Cable'bility* in action. At the free world's largest power project, as in other vital projects, large and small, Okonite cables have long been recognized as the *best for the job.*

*OKONITE Cable'bility...cable craftsmanship since 1878

Base plate bolts are tightened as final assembly of a pothead stress cone is made, prior to positioning of six-foot porcelain bushing. A total of 114 high-voltage potheads were used on this project.

One of the four pressure control units that automatically maintain oil pressure at 200 psi throughout the system.

THE OKONITE COMPANY
Subsidiary of Kennecott Copper Corporation
Passaic, New Jersey

where there's electrical power . . . there's **OKONITE CABLE**

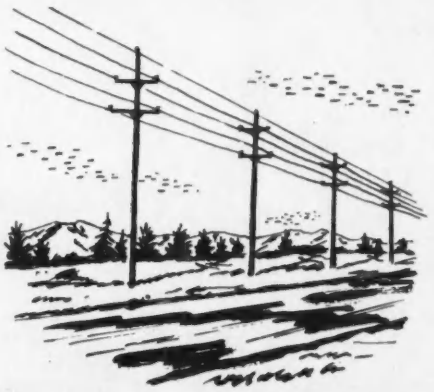
6179

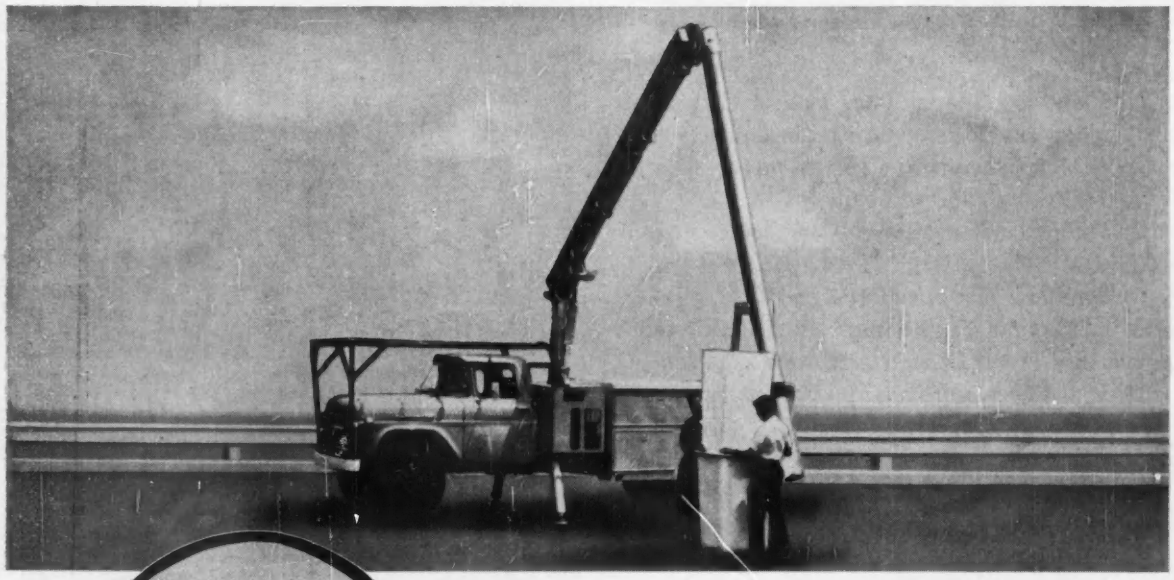
BASKET LINERS

Eliminate difficult basket tests

Dielectric safety is assured for the man in the aerial basket by the use of the newly developed Insert Liner. Eliminated is the costly and difficult task of a scheduled testing program on the basket itself. The liner, easily removed, makes it simple to maintain the necessary testing program for dielectric safety.

Every Asplundh Liner is tested by an independent testing laboratory and certified to 50,000 volts, or higher if desired.





Four ways you benefit

when you use an Asplundh Insert Liner

- No need to test the basket—test the liner only, keeping the lift in continuous use.
- Liners are inexpensive; keep an extra one available.
- Simple to store and easy to handle. Insert in a matter of minutes, no tools needed.
- Remove any water by simply emptying liner, thus saving time and inconvenience.

Remember, dielectric safety is yours with the "Big 3"—the **SPIRALLOY** Boom—the **SPIRALLOY** Pylon Mast Insert—and the Basket Liner—but only through Asplundh —most advanced designer and user of aerial devices.

Another important improvement by Asplundh, where "Future Developments" are Produced Today!

ASPLUNDH **Chipper Company**

Hamilton St., Chalfont, Pa.

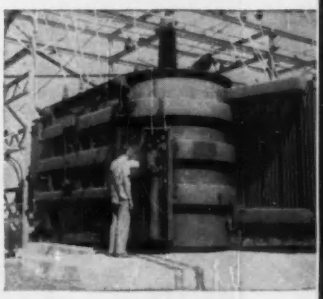
MORE POWER *to* OREGON

Specially Designed Moloney 230 KV LTC Transformers Installed Easily and Economically at The California Oregon Power Company's Lone Pine Substation

The bustling Rogue Valley, in the Medford, Oregon area, with its lumber, fruit growing and food processing industries attracted other industries. The resulting population growth created a need for more power. To serve this area's growing power demands, The California Oregon Power Company installed the Lone Pine Substation. A major station in the COPCO system, it supplies power for local 69 KV distribution and can also be used to tie a 230 KV transmission system to existing 125 KV transmission through the 69 KV bus.

Maximum dimensions of the transformers involved were vital since railway tunnels in the mountainous area imposed strict size restrictions. Moloney engineers designed to meet the need, complying with size limitations and yet retaining one-piece tank construction. This permitted shipment without special shipping cover and eliminated the necessity of field assembly.

Let Moloney . . . specialist in the solution of transformation problems, serve you . . . Specify Moloney for all transformation requirements.



COPCO's Lone Pine Substation has four Moloney Load Tap Changing Power Transformers rated at: 25,000/33,333/41, 667 KVA, Single Phase, Sixty Cycle, H.V. 127,020/220,000 Grd. Y. volts, L.V. 39,840/69,000 Grd. Y. volts, T.V. 13,800 volts at 9,000/12,000/15,000 KVA

ME61-17

MOLONEY ELECTRIC COMPANY

Manufacturers of
Transformers and Switchgear for Utilities, Industry, and Electronic Applications

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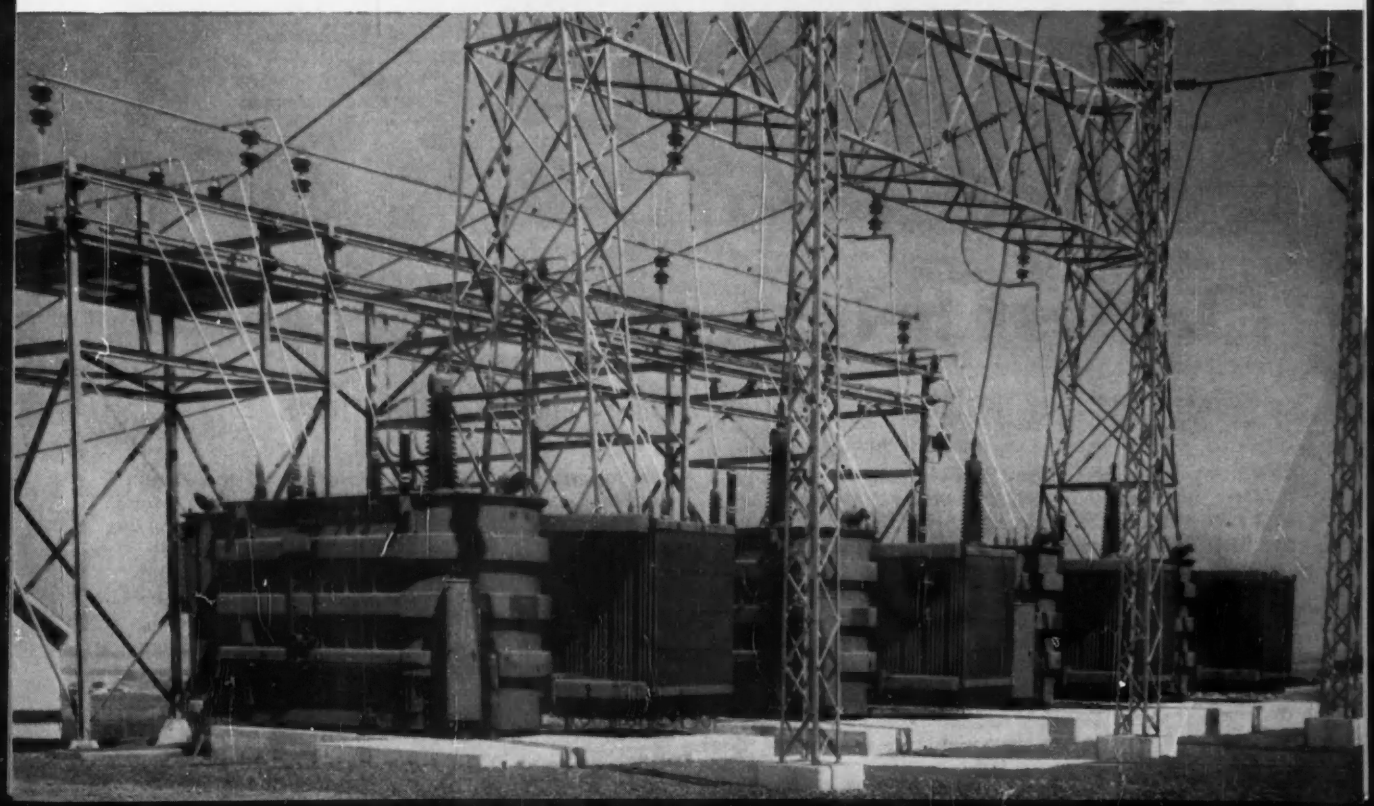

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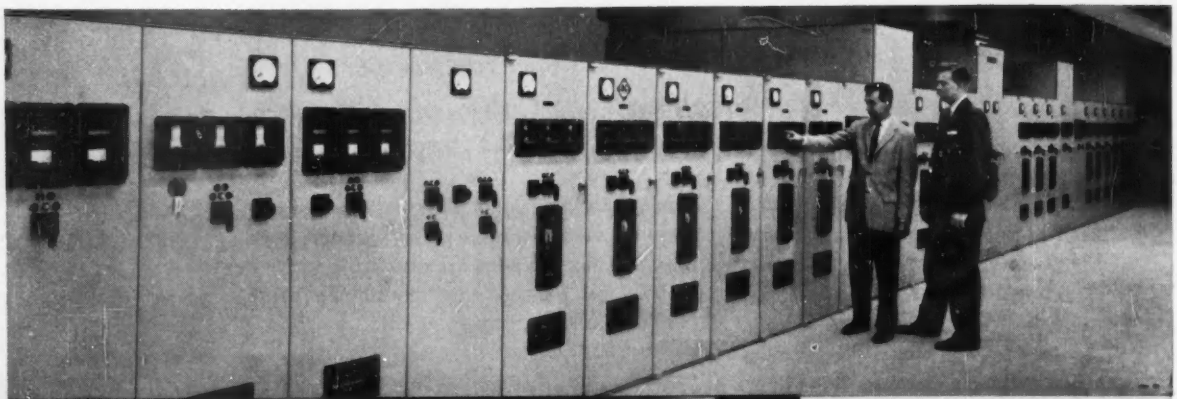
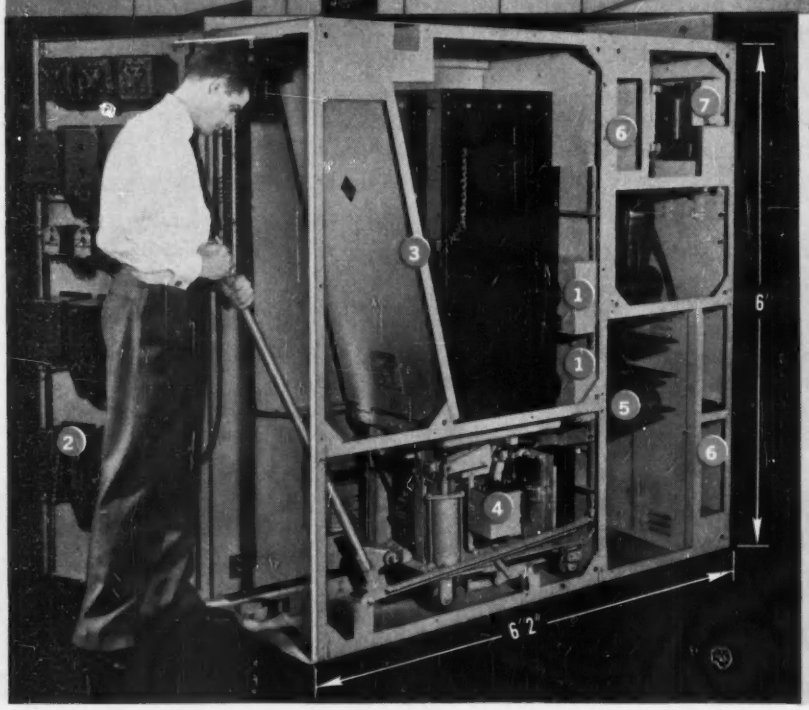




▲ 4.16 kv metal-clad equipment serving a west coast city.

1. Separate compartments for current transformers.
2. Full panel metering and relaying.
3. Double-lock panel for operator safety.
4. Easy service accessibility without dismantling.
5. Glass polyester insulation throughout.
6. Separate up-feed and down-feed cable compartments.
7. Fully cast, trunnion-mounted potential transformers.

Lowest height, easiest access

the only switchgear with fully isolated current transformers

The front-accessible current transformers can be inspected, maintained or replaced without exposure to any high voltage compartment. A-C metal-clad units are just 72 inches high — means eye-level instrumentation . . . shoulder-height accessibility of component parts. And the entire panel can be used for meters and relays. Maximum compartmentation and dead-front construction offer greater safety. Buswork and components arranged for easy addition of future units.

You get rapid, one-stroke insertion of the circuit breaker. The breaker has glass polyester insulation for highest impulse strength . . . the only self-locking protective barrier . . . four-bar linkage is mechanically, electrically trip-free. Primary disconnect fingers eliminate use of garter springs, and are on the circuit breaker for easy inspection. Both stored energy and solenoid operators are available. *For more switchgear information contact your nearby* **Allis-Chalmers** *office.* A-1457

Showdown Near on Crucial Hanford Power Bill

The Kennedy Administration moved deliberately last week to capture an important new beachhead in the electric power field. Its mission: To drive through Congress legislation authorizing immediate conversion of the Hanford New Production Reactor (NPR) for generation and commercial sale of steam electric power.

If it works, this bold stroke would put the Administration in a strong position to forge ahead with a vigorous policy of federal expansion in the whole electric power field. A victory for the Kennedy forces on the Hanford proposal, which is a part of the 1962 Atomic Energy Authorization bill, would mean:

- That federal construction of large steam power plants is no longer confined to the Tennessee Valley;
- That the AEC emerges as a new government power agency to take place alongside the Interior Department, TVA and the Army Corps of Engineers;
- That the federal bid for construction of the Bonneville-California EHV intertie is immensely strengthened;
- That a vital step has been taken toward federal government full utility responsibility in the Pacific Northwest.

First open fight on the Hanford facilities may come on the House floor this week or next, with Senate action to follow that. The House showdown tentatively had been scheduled for last Thursday, but was postponed. Perhaps growing opposition served to delay action.

Opponents of the NPR legislation have one major advantage as they enter the fray. They are now armed with persuasive arguments against the measure—arguments hammered together by a five-man minority of the Joint Committee on Atomic Energy (see page following). The minority report, issued June 23, served to highlight one issue that had been given little attention previously.

Wrote the minority:

". . .Congress must squarely face up to the issue of whether the AEC is to take its place alongside the Department of Interior and TVA as a major producer of government-generated electric power. This is a crucial question of national policy which must be debated and resolved by Congress."

The second major contribution of the minority report was to scotch the argument that the proposed power facilities at Hanford would play a critical role in US foreign policy. One argument has been that the dual-purpose plant is needed to give the US parity with Russia in negotiating a disarmament agreement. There has been a noticeable lack of direct opposition to the bill from investor-owned utilities until now, and there is strong reason to believe this lack stems from indecision based on this security-screened defense issue.

Now, however, the minority members of the committee, who had full access to all secret testimony on the bill, concluded: ". . .rather than aiding national defense, this project will stand as a major deterrent to an effective international agreement on (control of) nuclear weapons."

The issues are now clear.

There is no longer any reason why an all-out attack on this crucial, precedent-setting measure should not be mounted.

Joint Committee Reports on Hanford A-Plant

Condensed here are the opposing views on authorization of a 760-Mw power plant at the New Production Reactor (NPR) at Hanford, Wash. In approving the NPR provisions of the atomic energy authorization bill, the Joint Committee on Atomic Energy split 13 to five.

Majority Views	Minority Views
National Defense	
Reconversion for weapons plutonium production would be easy if disarmament agreements break down.	Easy convertibility to plutonium production would be viewed with suspicion by interests opposed to the US.
International Prestige	
To have a 700-800-Mw nuclear power plant, largest in the world, would have world-wide prestige value.	Poor steam conditions would in effect create impression of retrogression in generating methods.
Power Costs	
Studies indicate that large blocks of power would be produced at costs comparable with other means.	NPR power at 3.7 to 5 mills per kwhr compares with current average Bonneville costs of 2.62 mills.
Technological Benefits	
Conversion would give experience in making and operating large units for low-pressure, saturated steam, and for operation of large-scale nuclear power plant.	Technology obtainable from the reactor operation is available without adding generating facilities, and money is more useful in developing new techniques.
Economic Justification	
Otherwise wasted heat would be used for power production, and would bring cost of plutonium down.	FPC studies do not take into account $25 million in convertibility features nor any part of reactor cost.
Power Requirements	
Hanford operations would use 350-400 Mw of the power, releasing that much back to BPA for sale to investor-owned and public utilities of the region, plus having the remainder of the NPR output (760-Mw total) to meet power needs of utilities and industries.	Area power requirements can be met with projects planned or under construction by utilities of the region, and industries should not be lured from other parts of the country by a government power supply which is, in effect, a subsidy for industries.
Government Competition	
It is not intended that the government compete with investor-owned or public utilities in the production and sale of power. The BPA administrator says ten-year contracts with non-preference customers would be possible with availability of NPR power.	A government-owned steam power plant, first outside of the TVA area, sets a dangerous precedent, and BPA administrator's assurances are no substitute for specific provision that are not in the bill. AEC would be joining Interior and TVA as a power producer.
Preference	
Although power will be distributed under Section 44 of the Atomic Energy Act (giving preference to public bodies, cooperatives, or investor-owned utilities in high cost areas) investor-owned utilities and industries will be the major beneficiaries.	There is no legal guarantee that investor-owned utilities will receive NPR power because the Pacific Northwest is not a "high cost" area, and preference is clearly given to public bodies and cooperatives. Also, there is no five or ten-year "pullback" clause.
Other Points	
Plutonium requirements are on the increase and revenues from the sale of power would reduce its cost about one-third. First two years of operation of the reactor would be for plutonium production only, and then dual purpose operation would begin, tentatively scheduled for 1964.	No provision is made for operation of the plant. General Electric does not want to, and no one else is designated in the bill. Federal transmission lines to "high-cost" areas would be pushed if power is made available.

Racial Bias Denied by Con Ed

Consolidated Edison Co of New York, Inc, and local 1-2 of the Utility Workers Union of America have denied charges of racial bias.

Before a standing-room-only audience at a hearing of the House Committee on Education and Labor, Con Edison Vice President Bernard E. Gallagher said, "The company categorically denies that it discriminates on account of race, color, creed, national origin, age or any other reason, and its record and reputation bear this out."

Michael Sampson, business manager of Local 1-2, declared, "Any charge that this union is discriminating against any minority group or any member of a minority group is completely unwarranted. No such charges have ever been made within the councils of the union itself."

Con Edison and the local had been accused by witnesses before the committee of agreeing tacitly to restrict the advancement of Negroes (EW, June 12, p 48). One witness had charged that Negroes were restricted to the most menial jobs—mops, brooms, picks, shovels and jackhammers. Another witness had called the union "Jim Crow and lily white from top to bottom."

Con Edison issued a 90-page reply to these charges. The reply rebuked the committee for not having given the utility an opportunity to answer the charges when they were first made. "The committee knew in advance what these witnesses would testify to and yet no notice or opportunity was offered the company to be present," the statement said.

The company's statement further pointed out that although Con Edison has over 25,000 employees, only six specific complaints over the years since 1945 have been made to the State Commission Against Discrimination. The commission in each case found no merit in the complaints and completely exonerated the company.

A supplement to the statement showed that one of the witnesses who had charged Con Edison with bias had a record of excessive absences from work. He "should have been discharged on several occasions," the statement said.

Kefauver Looks at Motors

Competing electric motor manufacturers met periodically to discuss prices and general market conditions, the Senate Antitrust and Monopoly subcommittee was told last week, but effects of these meetings on the market place was unclear.

The subcommittee heard four executives from motor makers tell of meeting with their competitors several times a year until 1959.

They agreed prices were discussed at the sessions and, under intense questioning by subcommittee lawyers, said that on some occasions they left these sessions under the "impression" that price changes — either up or down — would follow. All, however, said no price agreements were made at the meetings.

Appearing before the subcommittee were A. C. Allen, sales manager of Wagner Electric Co, St. Louis; William Davis, manager of Allis-Chalmers Mfg Co's electrical department, Norwood, Ohio; Philip Scarola, motor sales manager of the Elliott Div of Carrier Corp, Jeanette, Pa., and James Kutz, manager of sales and engineering, Peerless Div of H. K. Porter Co, Warren, Ohio.

Electric motors were not included in products covered by federal antitrust charges against the electrical industry. Earlier testimony before the subcommittee, though, led Chairman Sen Estes Kefauver (D-Tenn.) to believe that price-fixing meetings had also taken place among motor makers and the subcommittee subpoenaed witnesses from this industry to question them along these lines.

Working from expense account records subpoenaed from motor makers, the subcommittee drew up a chart showing that executives from the companies had gathered at the same time in various cities.

Witnesses freely admitted they met from 1956 to 1959 but denied any pricing agreements were made at the meetings. Allen, for example, said competitors often met at a Hot Springs, Va., resort and "yelled" at each other for cutting prices. And Kutz said he met with competitors in Cleveland in July, 1957, and in Pittsburgh in August, 1957, where talks were "basically gripe sessions."

Subcommittee attorneys were puzzled by testimony that at most of the sessions General Electric Co executives were not represented. Davis said that a GE official was present at one session in Albany, N. Y., in February 1958, but other witnesses said they could not recall GE officials taking part in the meetings.

"Did you get the impression that some of the larger companies communicated with General Electric?" Kefauver asked Scarola. "I do not know," he replied.

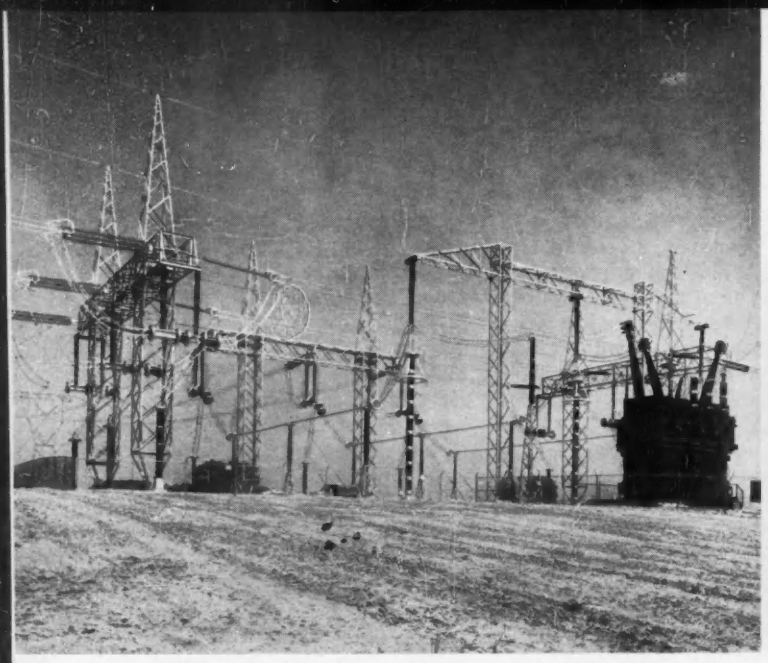
Meetings between motor makers, the witnesses said, took place both during National Electric Manufacturers Assn meetings and separate from NEMA sessions.

Brazil Starts Study of Giant Hydro Project

Brazil's Mining and Power Minister has named a group to study construction of hydroelectric project at Sete Quedas, one of the world's great waterfalls, on the Parana River between the Brazilian state of Parana and Paraguay. Total potential of the seven falls has been estimated at as much as 100,000 Mw.

The study group has 30 days in which to make its report, which is to include possibilities for making the project an international undertaking.

Sete Quedas is about 200 miles downstream on the Parana from the site of the 3,000-Mw Urubupunga project which six Brazilian states are undertaking with international financing. Several European consortiums are reported to have made proposals for Urubupunga.



APPLE GROVE SUBSTATION supplies three 2,400-ft line sections at left, right and rear. To extreme right are 138/750-kv, 125,000-kva main transformers and 528-kv station-type lightning arresters

GOVERNOR BARRON of W. Va., applauds as meter climbs toward 780 kv. AEP President Philip Sporn and A. C. Monteith, Westinghouse, look on

Apple Grove Test Station Dedicated

The country's newest EHV testing station—a $2-million, heavily-instrumented, three-line facility, sponsored by American Electric Power Service Corp and Westinghouse—swung officially into service late last month at Apple Grove, W. Va., on the Ohio River 25 miles north of Huntington.

As the switch was closed energizing the project, test instruments read very close to 780 kv. Thus a new voltage record was set for transmission systems around the world. It topped by a small margin the 770-kv level achieved at Project EHV a short week earlier.

Dedication of Apple Grove project launches a five-year research and test program designed to determine from corona and RI measurements the optimum conductor size and arrangement for future 750-kv lines. The present program extends investigations begun by AEP and Westinghouse in 1946 when they built the 500-kv Tidd project. Cooperating with the sponsors in the present project are six suppliers of components for the test facility.

In dedicating Apple Grove, AEP President Philip Sporn saw imminent need for 750 kv. With 3,000-Mw generating stations on the way and power systems covering larger areas, he said "vastly increased" transmission will be needed to integrate and coordinate capacities to handle these big stations and their loads. By the time the five-year tests are over, Sporn said he fully expects 750-kv lines to be ready for projection, design and construction.

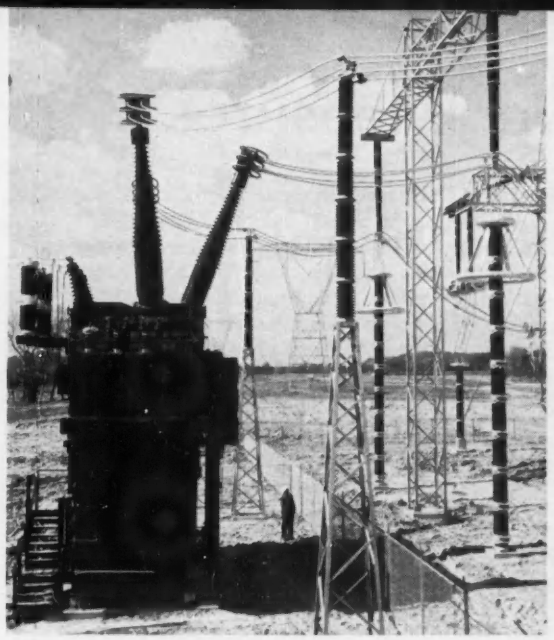
The Apple Grove test station comprises 2,400-ft three-phase tower lines radiating from a 138/750-kv substation. Project sponsors settled on the quadruple bundle as a necessity for 750 kv. From experience at Tidd and Leadville, Colo., they feel that proper cable size lies between 954 and 1,272 MCM. Thus one line uses 1,272 MCM (Pheasant) ACSR cable; the second 954 MCM (Cardinal) and the third uses Cardinal on outside phases but the larger Pheasant cable on the center phase to equalize surface voltage gradients on all three phases. On each phase conductors are in a quadruple bundle and spaced 18 in. apart. No other arrangements will be tried.

Simultaneous corona and RI readings can be taken on each of the lines. Such readings have the big advantage, project designers feel, of permitting direct comparison of performance among lines under identical conditions of weather and aging. RI blocking filters between the lines prevent interaction of RI generated on one line from effecting that produced on another.

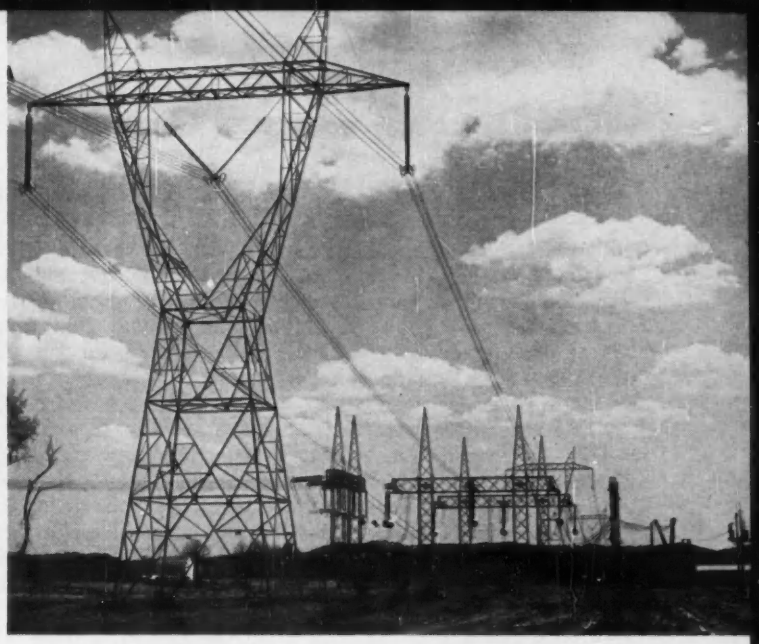
No load will be carried on the line. Artificial heating current is superimposed to simulate 1,000,000 kva operation and prevent condensation which distorts test results. Conductors in each phase bundle are insulated from each other and connected in series for this purpose. High-frequency by-pass filters at line terminals keep all conductors at the same potential for high-frequency currents.

Data logging equipment using magnetic tape scans and records 50 test quantities every 20 minutes; every two minutes when values get out of line. Readings include: temperature, relative humidity, air pressure, wind direction and velocity, radio influence, corona loss, air contamination and rainfall.

RI measurements are taken from six instrument houses under the midpoint of each of the three lines, three 100 ft and three 200 ft from the center phase. Noise meters in each group are of three different types; one Stoddard, one Griscom



AUTOTRANSFORMER rated 138/750 kv is 40 ft from base to bushing top. Graded post insulator stacks support jumpers. Arresters are at right



NORTH LINE looking toward substation shows typical steel tower with V-suspension string of 34 25,000 lb insulators restraining center phase conductor. Double strings of 15,000-lb units are outside

at 775 Kv: Sets New Record

and one Trebby type meter. Ambient noise is read 500 ft from each of the three lines.

Wattmeters in each phase of each line record corona loss using voltage from a one-turn tap at the high voltage end of the 750-kv transformer winding and the in-phase component of current in the test lines. An ultrasonic beam links the measurement site with the grounded data logging equipment.

Vital Statistics of Apple Grove EHV Test Project

CONDUCTORS—130,000 ft—ACSR
Guinea, 0.576 in., 12/7 stranding, OHGW
Cardinal, 1.196 in., 54/7 stranding, 4 @ 18 in.
Pheasant, 1.382 in., 54/19 stranding, 4 @ 18 in.
Chukar, 1.60 in., 84/19 stranding, 4 @ 18 in. (station strain bus.)

INSULATORS—34 5¾ x 10 in. per string
V-suspension strings—25,000 lb M&E
Four-string dead-ends—25,000 lb M&E
Two-string suspensions—15,000 lb M&E
Jumper Supports in station are 2,100-BIL post units in graded stacks of three 14-in. EHS and three 12-in. HS units

BUNDLE SPACERS—Stainless steel wire stranded on itself to form loop with clamps at 90 deg

TENSION SPLICES—30 and 37½ in. long; corona free at 1-million volts, no shields

LOAD BREAK SWITCH—138-kv, 600-amp disconnect with SF_6 interrupters

GROUNDING SWITCH—138-kv high-speed swinging-blade type

TRANSFORMER—125,000-kva, 138/750-kv, three-phase auto-transformer with taps for 687.5, 625,562 and 500 kv. **Bushings,** 1,800 kv BIL, height 24 ft

LIGHTNING ARRESTERS—528-kv station type

DECOUPLERS (RI filter chokes ad capacitors)
T-network: 2 milli henry and 5 milli henry chokes in series with 830 micro microfarad capacitor from midpoint to ground

DATA LOGGER—Prodac with 60-day tape capacity

PROJECT PARTICIPANTS—Sponsors; American Electric Power Service Corp and Westinghouse Electric Corp — **Cooperating Suppliers** — American Bridge Div, US Steel Corp; Armco Steel Corp; Kaiser Aluminum & Chemical Corp; Lapp Insulator Co; Ohio Brass Co; The Thomas & Betts Co, Inc **Contractors**—St Albans Builders Supply Co, Rao Electrical Co, Collier Construction Co, American Steel & Wire Div, US Steel Corp

Congress Acts on Power Measures

With the general outlines of the "New Frontier" federal power policy fairly well established, attention now turns to the treatment being accorded Administration power measures by Congress.

From Washington last week came this survey of the current situation on electric power legislation:

Generating facilities at Hanford reactor—Joint Atomic Energy Committee has approved authorization of 700 Mw of generating capacity for the reactor. Both the favorable majority report and a dissenting minority report were in the hands of legislators last week with action expected soon in both Houses (see pp 27-28).

Fryingpan-Arkansas reclamation-power project—This $170-million, 123,900-kw project may come up for House vote this year after winning quick committee approval. Senate will wait until House acts.

Burns Creek power project—This controversial 90-Mw power project, estimated to cost $50 million, is still before House subcommittee with future schedule uncertain. Senate subcommittee has held hearings, but will withhold further action until House subcommittee moves.

National fuels and energy study—Senate Interior Committee has completed hearings on this proposed two-year study, and favorable outcome appears likely for a geographically balanced special Senate committee or the Interior Committee to take on the $200,000 study with a final report due by January 1963.

Creation of a White House Resources Advisory Council—This measure has run head-on into objections from the Kennedy Administration, which would prefer to put resources planning under the Council of Economic Advisors and the Budget Bureau. Legislation now is in Senate Interior Committee.

Federal transmission line proposals—Senate Appropriations Committee is to begin hearings late this month on requests for funds to begin the proposed $176-million transmission network for the Upper Colorado project, funds for the proposed Trinity-Central Valley transmission lines, and other Interior Department requests. A House Appropriations Subcommittee has nearly completed marking up its bill and printed hearings were due out last week. Solid opposition to both Upper Colorado and Trinity was presented by investor-owned utilities behind closed doors of subcommittee sessions.

Rural electrification funds—House has approved a $195-million loan fund for Rural Electrification Administration of which $60 million would be for contingency purposes. This was $45 million above the Eisenhower Administration request, but less than President Kennedy had requested for the regular loan fund. The Senate still has to act.

Confirmation of Federal Power Commissioners—Kennedy Administration won handily on both, but the fracus over chairmanship is still unsettled (see p 29).

Reorganization of regulatory bodies—Kennedy Administration won the battle to reorganize the agencies, but has since been turned down on two plans it sent to Congress.

Standards to determine feasibility of federal projects—The "Trimble Bill" has been put on ice while Kennedy's budget director studies the subject and works on an Administration proposal.

Proposal for extra-high-voltage BPA-California intertie—This one is still in the study stage by the Administration with a report due this fall. With this may come proposals for modifying the preference clause to assure the Pacific Northeast of power developed in that area. It will be next year before Congress receives this hot potato.

Depressed area legislation including rural redevelopment funds—Authorizing legislation passed and Agriculture Department is now dickering with Commerce Department for an REA role in the rural areas.

Student Designs Electric Truck

Urban travel requires a low-speed, fumeless, quiet vehicle, thinks Marnie C. Averitt, one of six winners of Alcoa Student Design Merit Awards. This idea led Averitt to design an electric-powered runabout with 30-mph speed capability and 60-mile range (on one charge) selling for under $1,000.

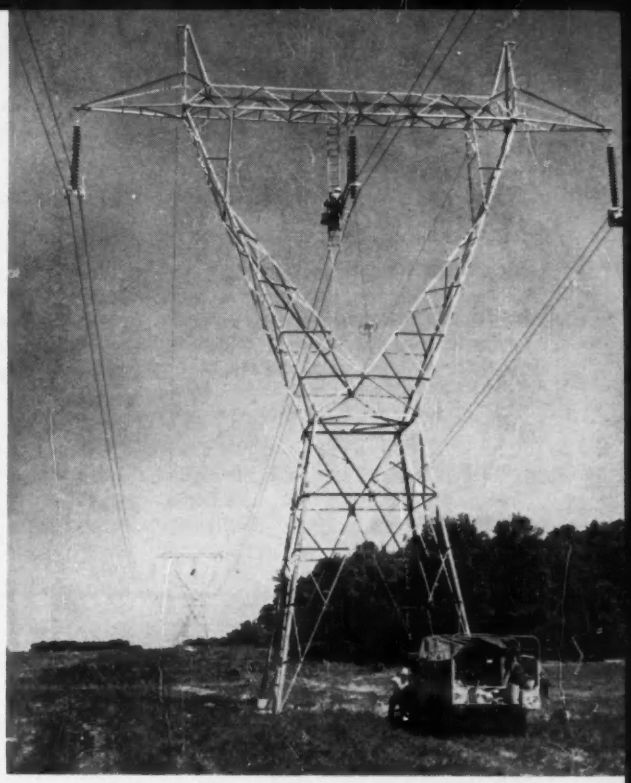
The vehicle, "Sparky," carries two passengers in a forward cabin and an 800-lb payload in its rear area. Six heavy-duty 6-v batteries take up 40% of the Sparky's weight when unloaded. Batteries, located under the rear deck, can be charged in 8 hr. Ultimate use of a fuel cell is planned.

A Special Report

Transmission Grid Ties N.Y. State Generation, Loads

- State-wide system now building is product of coordinated planning, design, construction and operation.....page 34

- Narrow-base 345-kv steel towers designed to fit New York's terrain and climate carry twin-conductor circuit....page 38



▪ Reaching across New York State from the north, west and south a new backbone of 345 and 230-kv lines is today being overlayed on existing 115-kv circuits. It creates a coordinated state-wide transmission grid that in many of the aspects of its conception, form and execution is unique.

Functionally the new EHV backbone lines link large new sources of hydro and steam generation at the northern and western rim of the state with seven centers of load and generation across the state and connect with the new 7,000-Mw, four-company Southeastern New York Power Pool supplying the greater New York City area. Ties at 230 and 115 kv interconnect the grid solidly with contiguous systems in neighboring states and Canada.

Creation of this $250-million transmission system has called forth a degree of cooperation and coordination that is outstanding in the industry's history. The joint undertaking has called for not only unification of planning and design, construction and operation among four electric companies and the State power authority but also sponsorship of interconnections involving in three adjacent states and Canada.

In the years that lie ahead the New York network will play a vital role in the effective pooling of power resources in the northeastern US. It will permit a sharing of emergency reserves over a broader area and it will link areas having diverse load patterns in a manner that will permit economies in required generation. Furthermore it will establish the basis for coordination of new plant construction within the state. And finally, creation of stronger ties within the state and among its neighbors will insure that the utilities will better withstand temporary loss of very large blocks of generation.

On the following pages *Electrical World* presents two related articles on the New York State grid. The first, authored by engineers of Niagara Mohawk Power Corp, presents the system pattern underlying the state-wide transmission network. The second, prepared by engineers of Charles T. Main, Inc, consultants of the Power Authority of the State of New York, details the design concepts of the 345-kv lines linking the Niagara Project with utilities serving Buffalo, Rochester, Syracuse, Utica and the adjacent territory.

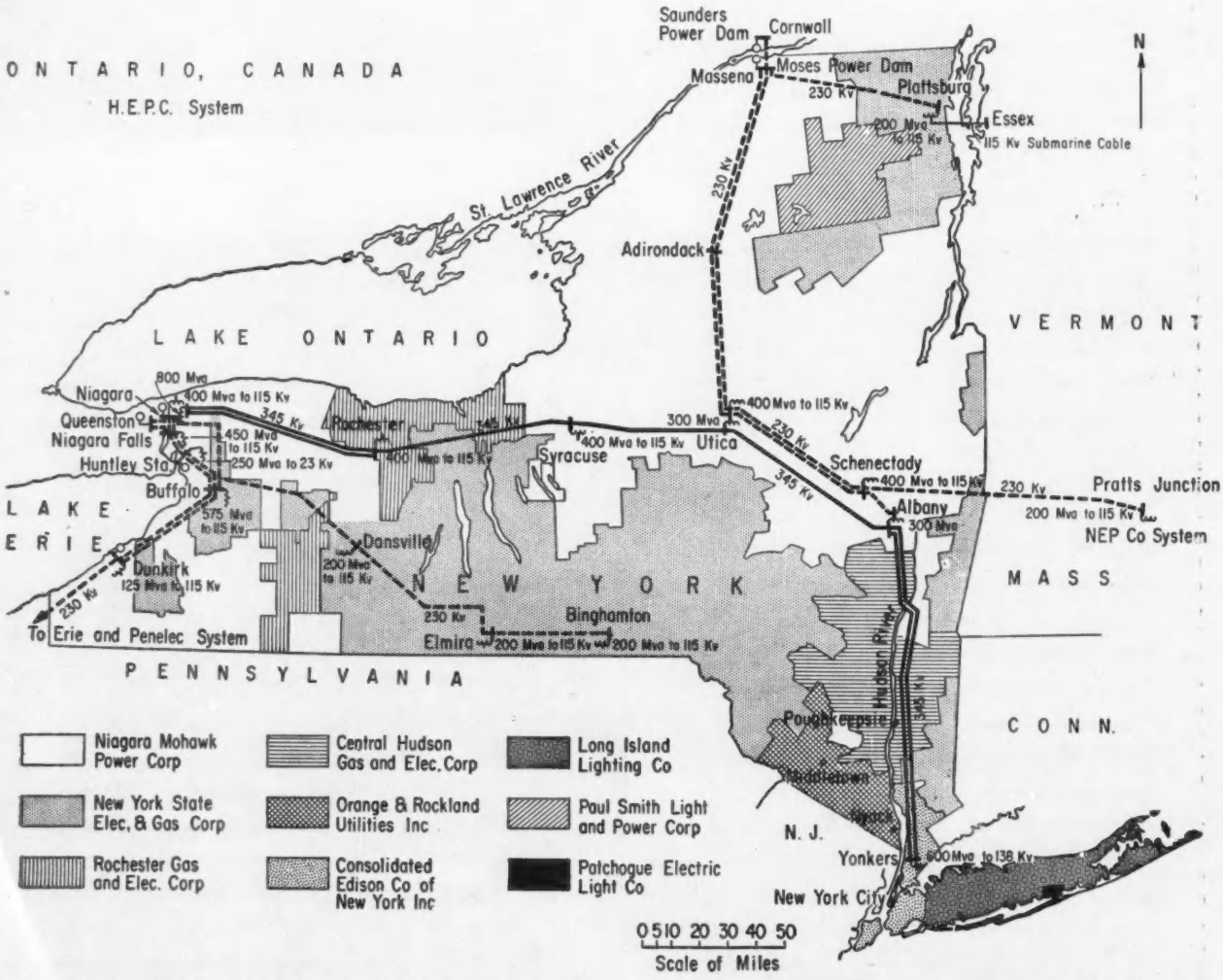
High Capacity Backbone Ties

State-wide system requires coordination in planning, design, construction, and operation not only of utilities in state but also with neighboring states and Canada

W. N. CARLSON, Administrative Engineer, Western Division, Niagara Mohawk Power Corp, Buffalo, N. Y.
H. L. HARRINGTON, Chief System Electrical Engineer, Niagara Mohawk Power Corp, Syracuse, N. Y.

The face and function of high-voltage transmission in upstate New York today is changing rapidly. A 345-kv backbone is being built across the state to overlay existing 115-kv systems. This backbone will connect to the systems in southeast New York through new 345-kv construction by Consolidated Edison. Also 230-kv facilities are being expanded in the western, eastern, and northern areas.

These changes have come about because big blocks of generation were added in the west and north. Large new steam units were added at Huntley and Dunkirk stations on the western edge of the state, some 900 Mw of new hydro generation was installed on the St. Lawrence, and hydro capability was expanded at Niagara Falls. These changes have dictated a strong transmission grid within the state and the reinforcement of ties with neighboring states and Canada.



TRANSMISSION SYSTEM of 345 and 230-kv overlays older 115-kv system and ties together major centers of New York state load and generation; all three voltages are meshed together by six million kva of transformers with in-phase tap changing under load but not quadrature control. The grid will interconnect firmly with Penelec at Erie, Ontario Hydro at Niagara and Massena, Vermont at Plattsburg, and New England Power Co at Pratts Junction

Generation and Loads in N. Y. State

Initially the grid will move power in blocks up to 1,000 Mw from plants on the state's north and west periphery to seven load centers spread across the state.

Later as power demands grow in the north and west, production there will be absorbed locally. Then the principal function of the grid will change:

- It will link new and existing generation for more effective pooling of power resources.
- Emergency reserves will be shared over a more widespread area.
- Ties between the southeast summer-peak area and the northern winter-peak area will pool the diversified loads, thus permitting a substantial reduction in total generation capacity required.
- Substantial gains in scheduling plant construction both in unit size and timing together with improved operating economies are expected.
- These advantages will be expanded through further coordination with neighboring systems.

Route of New York's 345-Kv Backbone

Starting from the New York State Power Authority's Niagara Project Switchyard, two Power Authority 345-kv circuits go east 70 miles to the Rochester Station, constructed by Rochester Gas & Electric. Here 345 to 115-kv transformation provides 400 Mva to serve Rochester and interconnect with the area generation and loads.

From Rochester, a single Power Authority 345-kv line goes east 80 miles to Syracuse and continues 50 miles to Utica. At both points, Niagara Mohawk (N-M) is providing the substations. At Clay Substation, 400 Mva of 345 to 115-kv transformation serves Syracuse and interconnects with generation and loads in central New York. At Edic Substation near Utica, a single 300-Mva, 345 to 230-kv transformer joins with circuits running north to the Authority's St. Lawrence Project and east to N-M's Rotterdam Station near Schenectady.

From Utica, a single N-M 345-kv circuit runs 83 miles east to the N-M's New Scotland Substation near Albany where one 300-Mva autotransformer will tie the 345 to the 230-kv system in the Capital area and to Albany Steam Station of N-M.

From New Scotland, N-M will build two 345-kv circuits to Poughkeepsie where Consolidated Edison will pick them up and continue to Yonkers—a total distance of 127 miles. At Yonkers, 345 to 138-kv transformation by Con Ed will provide 600 Mva to connect with New York City.

230-Kv East-West System Nears Completion

Also from the west, another 230-kv line now under construction by New York State Electric & Gas, will extend from the Authority's Niagara bus through the southern tier of New York State to the cities of Elmira and Binghamton. When extended eastward from Binghamton this will provide additional high capacity east-west transmission facilities. An additional 230-kv tie from the line at Elmira to the 230-kv system in Pennsylvania at Towanda is being studied.

Ties to Systems in Neighboring States

In addition to internal transmission, a number of ties to neighboring systems are being enlarged.

Two heavy 230-kv ties between New York State and the Province of Ontario parallel the two large systems. One tie is in the western end of the state between Niagara Falls, N.Y., and Queenston, Ont. Here 400-Mva transformers provide in-phase voltage matching facilities between the two systems. The other tie is a 230-kv line in the north from Cornwall, Ont., to Massena, N.Y., also with in-phase voltage regulation.

In the north from the Authority's facilities at Plattsburg, N.Y., a 115-kv submarine cable crosses Lake Champlain to Essex, Vt.

To the east, a joint project between New England Power Co and Niagara Mohawk will tie the two systems over a 230-kv line, 133 miles long, from Albany east across Vermont and Massachusetts to Pratts Junction west of Boston.

To the extreme west, still another reinforcing tie, now being erected by N-M, is a single 230-kv line from N-M's Dunkirk Station to the New York-Pennsylvania state line where it will join a circuit which Pennsylvania Electric Co is building as an extension of its 230-kv system in Erie.

This $250-million reinforcement of the transmission system, to be substantially completed by mid-1962, involves a degree of cooperation and coordination that is outstanding in the industry's history. Three electric companies—Niagara Mohawk Power Corp, Rochester Gas & Electric Corp, and New York State Electric & Gas Corp—together with the Power Authority of the State of New York worked to coordinate not only planning and design but also construction and operation of the portion of this statewide grid west of Utica. East of Utica and south into the metropolitan area, it is a joint undertaking between Niagara Mohawk and Consolidated Edison. In addition, the New England Power Co, Pennsylvania Electric Co, and Hydro-Electric Power Commission of Ontario are co-sponsors of new interconnections between their systems and the New York State grid.

A voltage of 345 kv was chosen to link the six terminals along the 400-mile transmission route across the state. At these points, the 345-kv circuits are tied to 115 and 230-kv facilities through transformers totaling 2,800 Mva. These 200, 300 and 400-Mva autotransformers are equipped with in-phase tap changing under load provisions but not with quadrature tap change equipment. Route of the line and location of the substation are shown on the accompanying map.

Breaker-and-Half Scheme

Clay Substation, 7 miles north of Syracuse, typifies the new 345-kv substations. Initially, this substation will have two 345-kv line terminals and seven 115-kv line positions. The 345-kv section initially is a four-breaker ring bus which can be expanded into a breaker-and-a-half scheme whenever additional 345-kv lines are added. But the 115-kv section will be breaker-and-a-half scheme from the start. Two 200-Mva forced oil and air-cooled three-phase autotransformers with 13.2-kv tertiary windings will connect the 345 to the 115-kv section.

Individual steel support structures are used to create a flat type station structure design. Pedestals with sta-

tion post insulators support rigid buses of welded aluminum throughout. Impulse insulation level for the 345-kv transformer windings is 1,175 kv protected with 80% arresters, and the associated switchgear and equipment bushings have 1,300-kv impulse withstand values.

The station is completely automatic with supervisory for metering and alarm only. Each 345-kv circuit is protected by two independent sets of relays. In turn, each relay set is actuated from independent bushing current transformers in the breaker, from different potential devices on the breaker, and works into separate tripping circuits. Back-up protection is provided in both 345 and 115-kv sections.

Fault values have been raised to relatively high levels, particularly at Niagara Falls, because of all the added generation and reinforced transmission system. This required that the 345-kv stations be designed for as much as 25,000-Mva short circuit capacity. In turn, 230-kv stations were designed for 20,000 Mva while 115-kv stations were designed for 10,000-Mva short circuit capacity. This high value for the 115-kv facilities is required even though the 115-kv system is split into two parts.

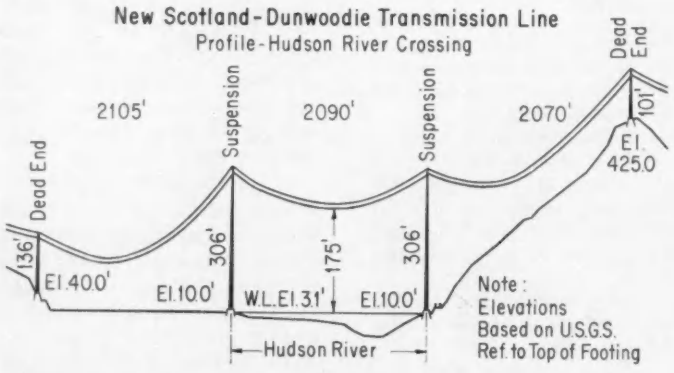
In planning the grid across New York and designing its protection scheme, both transient and steady state stability were studied extensively. Among the contingencies studied was sudden loss of 400 to 600 Mw of generation. These, and other contingencies, were carefully analyzed and weighed in designing the grid and its protection scheme.

The interconnected power system in New York is part of the Canada-US-Eastern Interconnection (EW, Nov. 9, 1959, p 54) whose generating capacities today exceed 40,000 Mw. As stronger ties are built and operate with the new protection scheme, the system will withstand such severe contingency conditions as the temporary loss of very large amounts of generation.

To increase over-all stability, substantial changes were made in protective relay facilities on the existing 115-kv system along with the 230 and 345-kv relaying schemes. Where in the past circuit protection was by distance relaying with remote backup, now distance relaying with local backup is used. This reduces circuit loading restrictions and prevents faults from triggering disruptive cascade tripping.

Protective facilities use microwave and carrier channels to obtain fast fault clearing for 100% of circuit lengths. In this way, fault burning damage and fault-caused mechanical forces will be reduced, stability improved, and high speed reclosing made practical. In addition, overreaching-permissive trip schemes prevent false tripping due to communication channel trouble.

Microwave and carrier are also used for operating communications, supervisory control, remote metering, load dispatching, and system data collection for the central economic dispatch computer.



RIVER CROSSING uses high strength conductors to reduce tower heights but still requires 310-ft towers to clear water surface by 174 ft

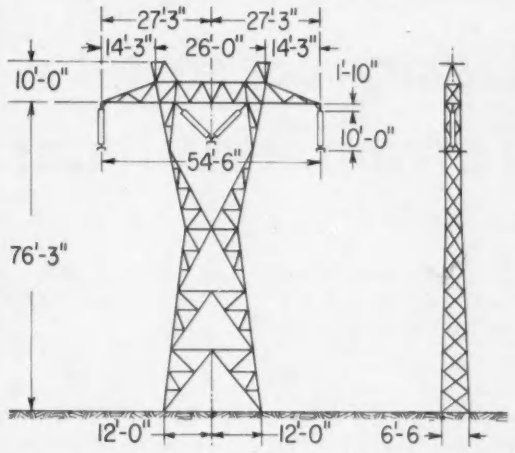
RIVER CROSSING DATA

Voltage	345 kv
Configuration	Horizontal
Circuits	Two
Number of lines	Two
Conductors	Twin bundle 795 MCM 30/19 ACSR; 18-in. horizontal spacing; bundle tension (NESC) heavy loading 28,000 lb max
Ground wires	Two ½-in. 7 strand Alumoweld; tension (NESC) heavy loading 8,000 lb max
Insulators	Suspension: 2—18 unit string B&S. 5¾ in. by 10 in., 25,000 lb units Dead end: 2—18 unit string B&S. 5¾ in. by 10 in.—36,000 lb units
Towers	C.A. Inc. steel waist type. Suspension: type 3HR—weigh 48.5 tons Dead end: type 3FR—west bank line no. 91—30.3 ton; west bank line no. 92—22.1 ton; east bank—20 ton each.
Foundations	Suspension: steel piles with concrete caps. Dead ends: earth grillage with concrete pad.
FAA Requirements	Marker beacons, obstruction lights and flood lights on suspension towers only. Painted 34-ft wide alternate orange and white bands.

Upstate One System

To achieve over-all economy, the upstate utilities and the Power Authority have developed coordinated operating procedures in three general areas: (1) production costs; (2) switching coordination; and (3) maintenance scheduling.

For years the operating utilities have held production costs to a minimum by pooling capacity and coordinating maintenance. Coordinator of these activities was Niagara Mohawk's system power control office. With such a large area to coordinate, manual determination of economic energy interchange became so complex that an Economic



345-KV TOWER carries two ground wires as well as bundled conductor circuit with middle phase restrained

TOWER DESIGN DATA

Max. voltage of tolerable operating zone	362 kv
Type of construction	Single circuit, steel waist type
Configuration	Horizontal
Conductor	Two 795 MCM 26/7 ASCR cables per phase
Conductor bundle spacing	18 in. horizontal
Max. bundle tension (NESC)	Heavy loading—17,000 lb
Max. ground wire tension (NESC)	Heavy loading—6,000 lb
Suspension insulators	One 18-unit string of 5¾ in. by 10 in., 15,000 lb units
Angle suspension insulators	One 18-unit string of 5¾ in. by 10 in., 25,000 lb units
Dead end insulators	Two 18-unit strings of 5¾ in. by 10 in., 25,000 lb units
Basic impulse level	1,550 kv
Ruling span	900 ft
Shielding angle	35 degrees
Normal tangent tower weight	3.5 tons

Dispatch Computer of the analog type was installed in Syracuse in 1959. The computer determines steam unit outputs for minimum overall production cost of the New York State Electric & Gas and the Niagara Mohawk areas considering plant input-output characteristics, fuel costs and incremental transmission losses.

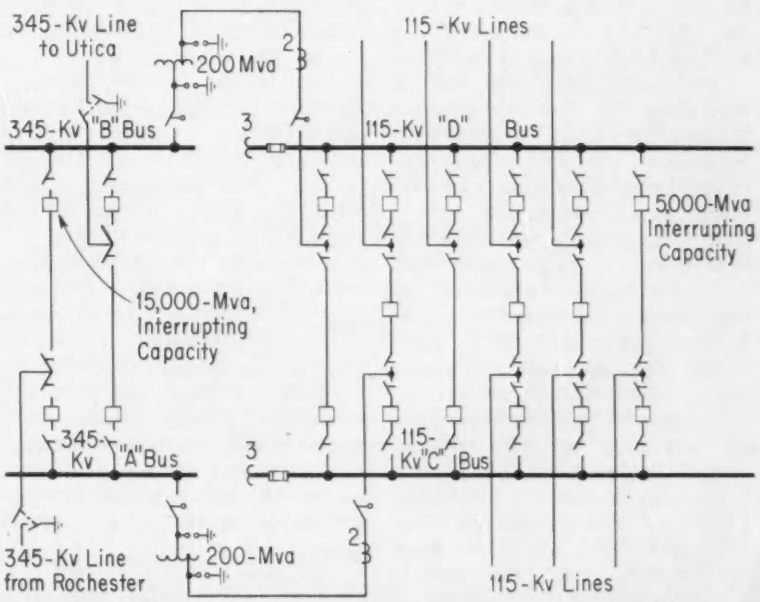
The St. Lawrence River generation is included presently in the computer. The new Niagara generation and new transmission lines will be added to the computer as they come into operation. By then, the computer will include all major generation and transmission facilities in upstate New York.

Deliveries from Niagara and St. Lawrence hydro generation and other hydro sources are set into the computer on a scheduled basis together with estimated area loads. The computer then prints out optimum steam unit outputs, and the cost and value of energy interchanged with neighboring systems.

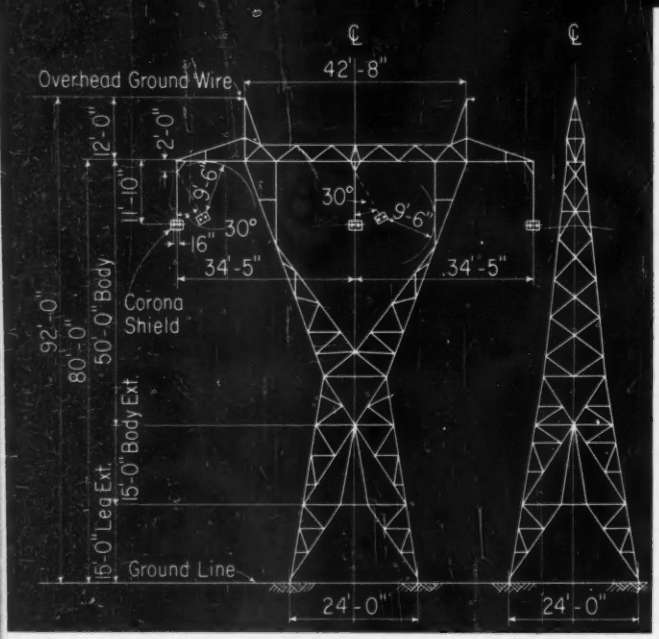
The ultimate load and frequency control methods for upstate New York are also under continuing study. Today Niagara Mohawk regulates by three separate area controls—western, central and eastern divisions. The western division includes Rochester Gas & Electric as well as part of Niagara Mohawk and New York State Electric & Gas systems. The central division includes Niagara Mohawk's central area and the Power Authority's St. Lawrence generation and its directly associated loads. The eastern division includes Niagara Mohawk as well as a small part of New York State Electric & Gas load. A separate load control is operated by New York State Electric & Gas for its south-central system.

The State Power Authority is installing load control equipment to regulate the output of both its Niagara and St. Lawrence generating stations. Niagara Mohawk is now studying whether it should convert its three-area control to a single-area control. Should this be done, provisions are being made to control the combined Power Authority and Niagara Mohawk areas by varying the output from either the Authority's Niagara development or Niagara Mohawk's steam electric

(*Continued on page* 48)



345-KV SECTION uses ring bus expandable to breaker-and-a-half as more circuits are added; 115-kv section starts out as breaker-and-a-half scheme



345-Kv Towers Designed to Fit Terrain and Climate

SUSPENSION STRUCTURE has square base, 50-ft body. Shown are 15 ft body and leg extensions. Ten tower types were used in the entire line

ANGLE STRUCTURE is 45-deg type (TA2 in table). Jumper sag on each side of tower loads down suspension insulator string to minimize radio interference

EHV transmission line for PASNY was energized July 1; 1,801 towers carry twin 795-MCM ACSR single circuit

R. E. MORAN, Electrical Engineer, Charles T. Main, Inc, Boston, Mass.

A 345-kv transmission line is now under construction by the Power Authority of the State of New York from Niagara Falls to Utica, N. Y. This line is being supported on towers specially designed for this rolling terrain and climate and is being supported on production-line hardware. This Niagara-Adirondack Tie Line will consist of 270 miles of single circuit construction.

Two single-circuit lines will extend from the Power Authority's Niagara Switchyard to Rochester Substation; one single-circuit line, from Rochester Substation to Clay Station near Syracuse; and one line, from Clay Station to Edic Station near Utica. A single circuit from Niagara to Rochester and on to Clay was placed in operation July 1. The remaining two lines will be completed later this year. Operating voltage of the lines is 360 kv.

Niagara Mohawk Power is constructing Clay and Edic Stations and Rochester Gas and Electric Corp, the Rochester Substation. This entire extra-high-voltage transmission system, which is being superimposed upon the existing 115-kv interconnected system, is being expedited to keep pace with the output of the Power Authority's Niagara Power Project, which will have more than 2,000-Mw generation.

Prior to selecting the basic tower design, extensive studies were conducted to determine the type of structure most adaptable for transmission lines in this area. Terrain, climate, voltage levels, construction cost, maintenance expense, tower performance and lightning probability were among the many factors considered in evaluating the various structures available.

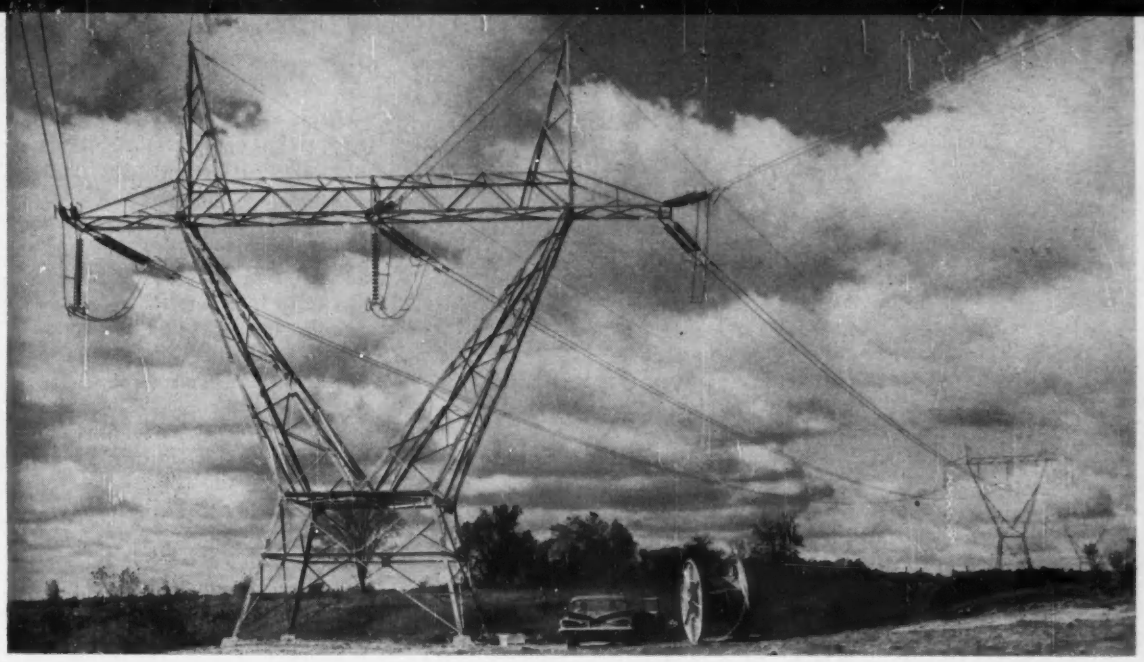
The terrain in the Niagara-Rochester section is generally open and flat with rolling hills. Drumlins dominate the Rochester-Syracuse section. Between Syracuse and Utica, the line extends across some drumlins, which gradually give way to rolling hills. Considerable swamp areas exist over the entire line. The area is subject to severe winter weather, which causes extreme line loading. The isokeraunic level is 30.

Special emphasis was given accessibility of the right-of-way, which is 300 ft wide, for heavy construction equipment, for repairing damage due to vandalism, and for other operations external to line operation.

The basic structure selected is a single-circuit, waist-type suspension tower with a square base and with main members of high-strength steel. The basic tower height is 80 ft to the crossarm and 92 ft to the peaks that support the two overhead ground wires. This provides a height of 68 ft to the point of suspension of the conductor. Leg and body extensions permit variation of the tower height and base to conform to local terrain. On the section with two circuits, the center lines of the two circuits are 150 ft apart on the 300-ft right-of-way.

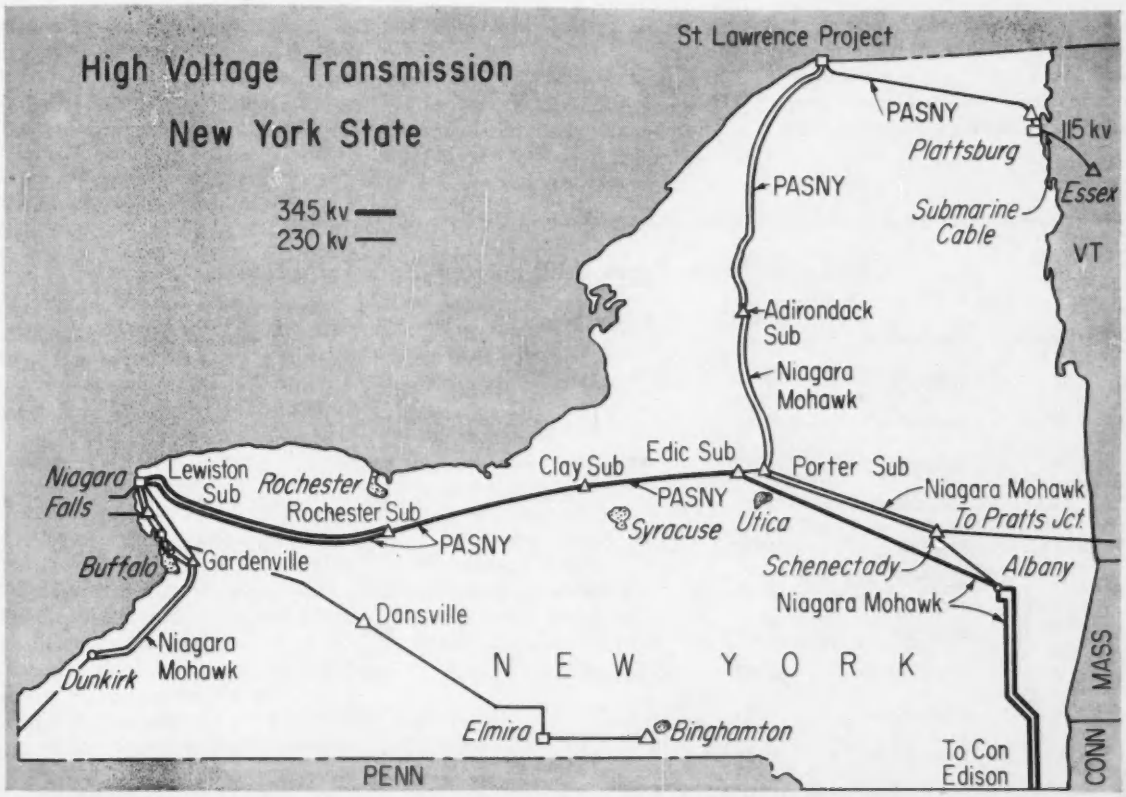
In the determinations for the detail design of the suspension tower to be used at most locations and for special towers, a preliminary line location was analyzed prior to selecting the final route. A series of towers designed for the particular terrain was considered to be more economical than adapting a single minimum-weight suspension tower to the various tower locations. The special towers were designed to match the loadings at the points of application so that the total line approaches uniformity of tower strength vs calculated loading.

The evaluation of the preliminary route consisted in estimating the average and maximum spans, average tower height, number of structures per mile and foundation details for the suspension structures. The points where the line changes direction and angle structures are required were approximated. From this preliminary analysis, the engineers selected the number and the range of applications of special structure types. A summary of the



final tower design types and application is shown in Table I.

The basic tower design is generally based on the recommendations of the National Electrical Safety Code, Heavy Loading (5th edition). The tower strength is based on a transverse wind load of 4 lb per sq ft on the projected area of all conductors and overhead ground wires covered with ½-in. radial ice at 0F and a vertical load based on the weight of these ice-covered conductors for the maximum spans. As an added safety precaution against ice loading that the twin-conductor configuration might cause, an alternative vertical load of 1½-in. radial ice at 32F around all conductors and overhead ground wires was included in the design. The



270 CIRCUIT MILES OF PASNY line connect Niagara project with Utica. Utility company lines are also shown

clearance from line parts to tower is 7 ft 6 in. with an insulator swing of 45 deg. All suspension insulators are free swinging.

In addition to meeting the safety code, longitudinal loads were applied at the points of attachment of insulator strings supporting the conductors and at the overhead ground wire peaks. This longitudinal load was estimated at 8,250 lb at the crossarm hanger and 5,000 lb at the tower peak. Only one of these loads was assumed to be applied under any one loading combination. The longitudinal loads on the strain towers (T1, T2, TA1 and TA2) were calculated at 16,500 lb at the crossarm and 5,000 lb at the tower peak. For the dead-end tower (type D), an unbalanced longitudinal load was established which would result from the load of all wires being installed on one side of the tower under the conditions established for heavy loading and no loading on the other side.

The foundation for most structures is a light-weight galvanized steel grillage installed at a depth of 8 ft. In order to adapt this basic foundation design to the wide variations in soil types along the line, bearing pressure for calculating the grillage was limited to 4,000 lb per sq ft. Where the soil is not suitable to withstand this loading or where ledge is encountered, these modifications of the grillage installation were specified:

1. Replace poor bearing soil by compacted gravel or crushed stone.
2. Install enlarged area bearing mats of creosoted railroad ties.
3. Install 12-in. concrete mat encasing grillage.
4. Install single H-pile at each tower leg and connect piles by reinforced concrete grade ties. Install stub angles for connection to tower legs.
5. Install stub angles in concrete anchored in ledge.

All foundation steel is grounded by a simple crowfoot counterpoise. After installation, a series of three ground resistance measurements was made at each tower. These measurements were logged with pertinent soil and weather data. From these data, a ground-resistance profile is plotted, which will be evaluated for each line section to determine if any additional ground rods or counterpoise will be required. For a distance of a half mile near the Niagara Switchyard and the substations, tower footing resistance was reduced to a maximum of 5 ohms. For the remainder of the line, the resistance profile will be evaluated, and additional grounding will be installed at towers with high resistance.

The line conductors are twin 795-MCM ACSR Drake spaced 16 in. horizontally, and the overhead ground wires are 190.8-MCM ACSR Dorking. The conductors and overhead ground wires are coordinated to complement the tower design and achieve economy consistent with performance requirements. The ultimate selection of conductor type and size is a compromise among capability requirements, radio influence voltage (RIV) considerations, corona and resistance losses and construction requirements. The last consideration precluded design of the two-unit line conductor with minimum theoretical horizontal spacing. The 16-in. separation selected represents a compromise among RIV, corona loss, line reactance and construction costs.

During manufacture, the Drake conductor was treated with extra care by the manufacturer to obtain a perfectly smooth surface. Prior to reeling, the finished strands were passed through a vacuum, where a series of nylon brushes removed all surface dirt and grease. Special care was exercised during reeling, handling and shipping to avoid any movement of the layers of conductor on the reels which would damage the conductor surface. All conductor and overhead ground wire was shipped on steel reels of 8,600-ft capacity.

The conductor stringing is being performed under tension and no

Table I—Ten Tower Types Used on New York State Line

Designation	Application	Weight, tons	Normal Height to Crossarm, ft	Maximum Span, ft	Maximum Line Angle, deg	Quantity
S1	Suspension	5.19	80	1,000	0	1,601
S2	Suspension	5.82	80	1,500	0	39
SA1	Suspension	6.12	80	900	4	37
SA2	Suspension	6.86	80	900	10	32
T1	Strain	6.55	68	1,000	0	9
T2	Strain	6.85	68	1,500	0	2
TA1	Strain	7.91	68	900	15	14
TA2	Strain	12.02	68	900	45	46
X	Transposition	8.53	78	700	0	15
D	Dead End	9.51	68	1,000	0	6
						1,801

general brushing or polishing is done. Special care is exercized to polish smooth all surface scratches caused by temporary holding devices and those resulting from splicing operations. High-voltage tests were made on the conductors without fittings before stringing to see what special handling during the stringing would be required. After initial stringing operations had been completed, representative conductor samples were selected from several sections of the completed line and tested to ensure that the stringing operation had not increased the RIV level.

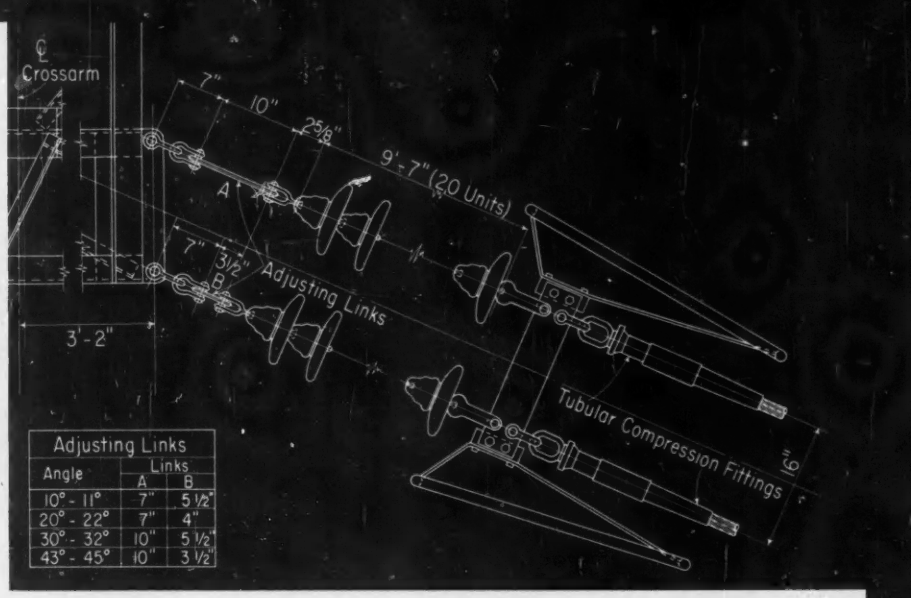
To utilize the experience of the hardware manufacturers and of other utilities to maximum advantage, standard line hardware was selected where available to meet performance requirements. To evaluate conductor hardware and spacers, samples were subjected to a series of high-voltage and mechanical tests, during which many different arrangements of suspension and strain assemblies were tried.

The conductor suspension consists of 18 25,000-lb code gray insulator units and preformed armor rods with cast aluminum clamps and neoprene inserts. At structures where the span weight exceeds the limit for the 25,000-lb units, single strings of 36,000-lb units are installed.

At strain towers, two strings of 20 25,000-lb units are installed for each phase. Each string of insulators is attached separately to the tower and to one of the two conductors per phase. No yoke plates are installed. Spacing between the two strings is maintained by a strut of the corona ring. This unit arrangement for conductor and insulator string ensures that the two strings of insulators as well as the twin-conductor arrangement will remain in the horizontal plane.

Where angle structures occur, links of different lengths are installed at the tower end to align the insulators at the corona ring (drawing). No turnbuckles or adjustable fittings of any kind are included. Even though no adjustments were provided, the contractor is able to install the conductors with extreme accuracy.

The lightly loaded idler string of suspension insulators at strain towers posed the greatest threat of RIV. A series of tests on the first conductor section was made to determine how much swing to anticipate for these suspension insulators. At three suspension towers of approximately equal level spans, the conductor was made to swing through arcs up to of 45 deg. The amount of force required to cause this swing was recorded for the maximum swing and for intermediate points. Similar tests were made for the jumper strings on a strain tower. The comparison of these tests yielded a factor representative of the resistance to swing of the jumper conductor. This factor was applied to calculating the idler swing at the strain towers. Where the restraint provided by this jumper string was required, it was formed to sag at each side of the tower to impose the maximum vertical load on the suspension insulator (photo p 39). Elsewhere, the idler string was eliminated.



ADJUSTING LINKS for 45-deg angle-structure string align insulators on two strings and eliminate turnbuckles

Table II—Niagara-Adirondack Tie Line Statistics

GENERAL
- Voltage, Nominal—345 kv
- Length of Line—270 miles
- Origin—Niagara Switchyard
- Termination—Edic Station (Utica)
- Period of Construction—1959-1961

STRUCTURE
- Material—Steel
- Main Members—ASTM-A242
- Secondary Members—ASTM-A7
- Average per mile—6.5
- Average Span—800 ft
- Ruling Span—1,000 ft
- Maximum Span—1,500 ft
- Configuration—Horizontal
- Phase Separation—34 ft 5 in.

SURGE PROTECTION
- Ground Wires:
  - 2 190,800 CM, ACSR Dorking
  - Maximum Design Tension—5,300 lb
- Shielding Angle—30 deg
- Mid-span Separation at 60F:
  - Average Span—31 ft
- Tower Separation—25 ft

CONDUCTORS
- 2 795,000 CM, ACSR Drake per phase
- Bundle Spacing—16 in.
- Final Sag For Average Span at 60F—27.2 ft
- Maximum Design Tension—15,000 lb/phase
- Clearance to Ground at 60F:
  - General—32 ft
  - Pedestrian area—27 ft
- Altitude Range—350-900 ft

INSULATION
- Suspension:
  - 18 5¾ x 10 in., 25,000-lb units
  - 18 5¾ x 10 in., 36,000-lb units
- Strain:
  - 20 5¾ x 10 in., 25,000-lb units

PVC CONDUIT dodges water pipe (foreground) by change from five wide, four deep to ten wide and two deep

RAILROAD TRAFFIC was not interrupted by PVC-conduit installation in open cut under downtown Tampa tracks

PVC Pipe Outlasts Encased Duct

Survives in Tampa downtown network where ground settling starts concrete duct failures; easier to work and install

HARRY HORTER, Underground Engineer, Tampa Electric Co, Tampa, Fla.

Polyvinyl chloride (PVC) pipe outlasts encased duct in the Tampa Electric Co's downtown network system. PVC conduit is less susceptible to the soil conditions peculiar to the Tampa area and is easier to handle and install. The company's experience with it dates back to 1958.

In and around Tampa, the water table is near the surface, in some places a bare 30 in. below grade. In such places the ground is prone to settle, taking concrete encased duct with it and breaking it in such a way that cable cannot be pulled out or in. Some earth settling is also attributable to vibrations set up by vehicles. And, of course, a contributing factor to duct failure is the poor job of pouring done on the uniform concrete jacket in many places and the poor quality of the concrete.

Use of PVC conduit eliminates these problems: It is not readily susceptible to damage due to ground settling and there is no poured concrete jacket. Furthermore, in installation, it can be routed around obstacles and easily joined. Street obstruction time is much shorter.

Tampa Electric's first PVC-pipe installation on the network system was in a sidewalk, a connecting duct between a transformer vault and a sidewalk handhole. It consisted of four rubber-covered, 500-MCM secondary network cables. There was an unusual number of pipes and other obstructions. The installation of rigid conduit would have been time-consuming and would have required a complicated series of transitions. The rigid conduit also would have had to be encased in concrete in a considerably deeper ditch in order to circumvent all obstacles.

Schedule A PVC pipe was used. Quite flexible, it was installed in a few minutes once the trench was dug to the proper depth. No bend fittings were used.

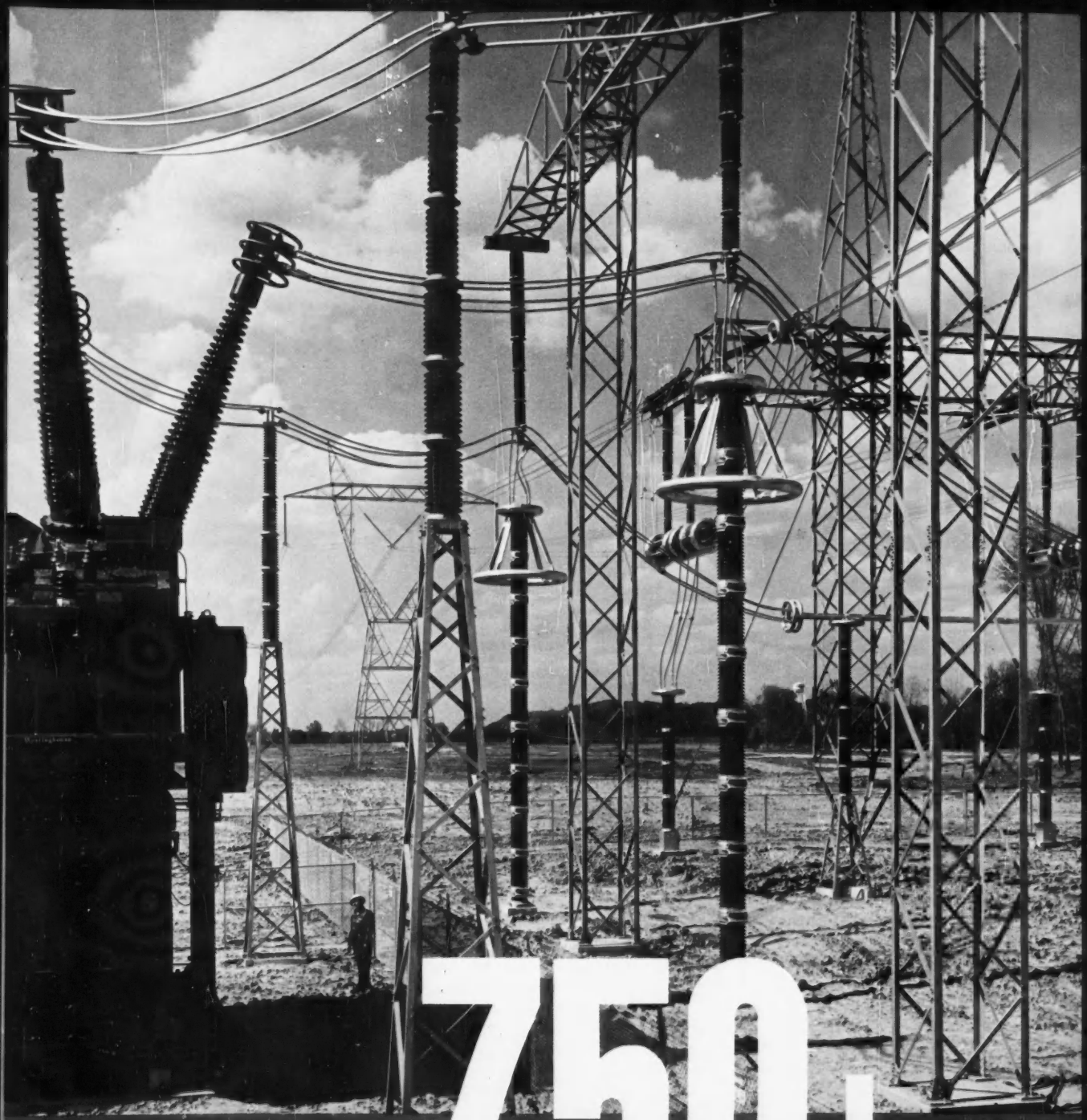
Perhaps the greatest advantage accruing to PVC pipe is the ease of joining the ends. An ordinary handsaw cuts it easily and quickly. The joint is made simply by coating the ends with a welding solvent and slipping on a coupling. A taper cutting tool is unnecessary.

There is no breakage in handling and installing PVC pipe. Nor is there any damage to the ends with couplings. Although the cost of damaged conduit of any type is negligible, delays in repairing or replacing it are often troublesome and costly.

PVC conduit does not crush after installation, as often happens with other conduit (except steel) when not encased in concrete. PVC pipe's smooth interior reduces the cable pulling tension required.

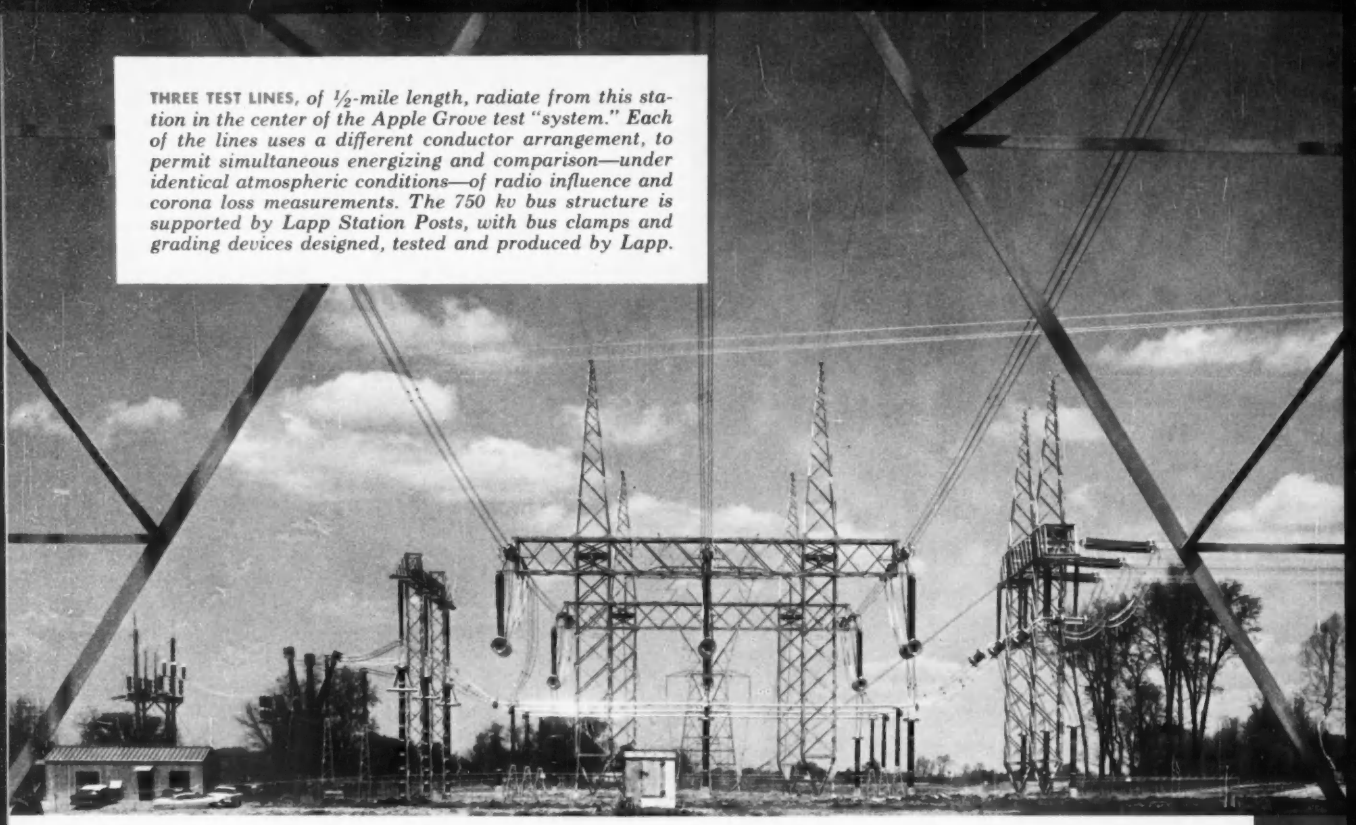
PVC conduit is laid without a

(*Continued on page* 62)



750 kv

LAPP SUSPENSION INSULATORS
LAPP 2100 BIL STATION POSTS
AND CORONA GRADING DEVICES
ON APPLE GROVE TEST PROJECT

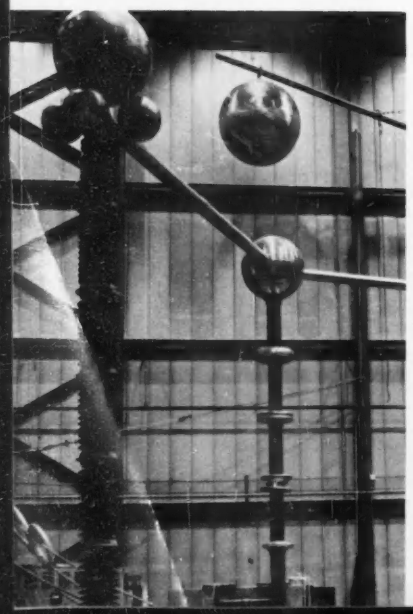


THREE TEST LINES, *of ½-mile length, radiate from this station in the center of the Apple Grove test "system." Each of the lines uses a different conductor arrangement, to permit simultaneous energizing and comparison—under identical atmospheric conditions—of radio influence and corona loss measurements. The 750 kv bus structure is supported by Lapp Station Posts, with bus clamps and grading devices designed, tested and produced by Lapp.*

"... to push forward the frontiers, both technical and economic, of transmission to levels up to 750 kv"

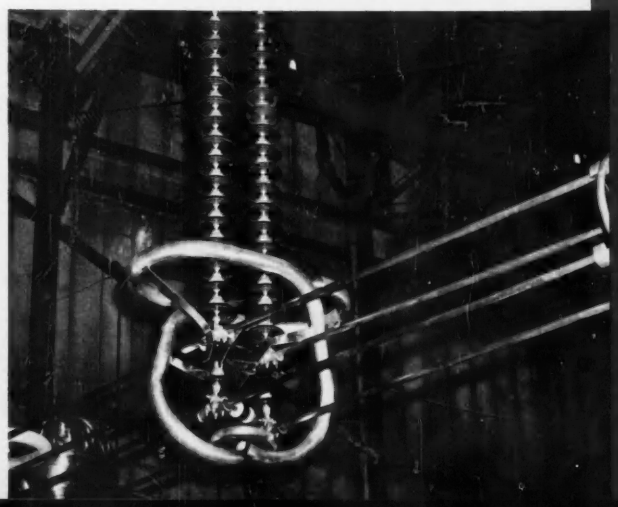
—Philip Sporn, March 28, 1960

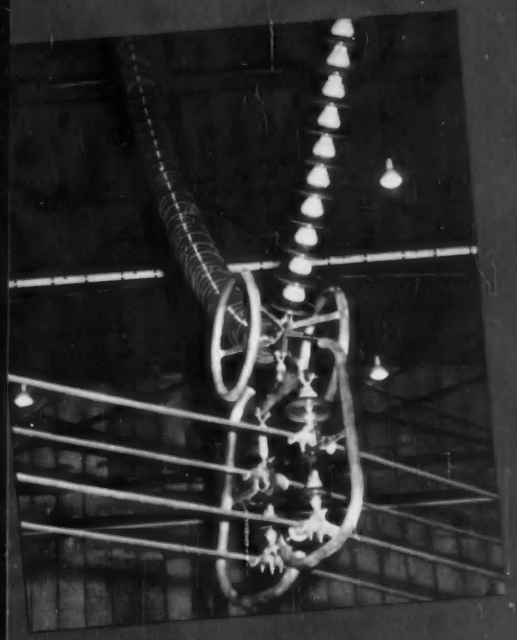
On June 22, 1961, the Governor of West Virginia closed the switch, the lines were energized, and a three-to-five year testing program of transmission at 750 kv was begun, co-sponsored by American Electric Power Service Corp. and Westinghouse Electric Corp. Lapp Insulator Co., one of six other manufacturers participating, is proud to have been able to contribute its technical and production facilities to the design, testing and manufacture of insulators, corona control devices and other hardware for this project. As a result, Lapp is now qualified to supply such material, of known characteristics, for transmission line and substation use at any presently-contemplated EHV.



TEST *(left) of 6" IPS tubular conductor for corona-RIV characteristics. A series of such tests conducted in the John Lapp High Voltage Laboratory on bundled conductors, cable splices, clamps, T-taps and jumper fittings provided important data for the Apple Grove project.*

GRADING DEVICE *(below) for suspension point of four-bundled conductor. Novel configuration provides effective shielding in a compact, easily assembled, economical design. The small insulators isolate lower conductors, for test purposes.*

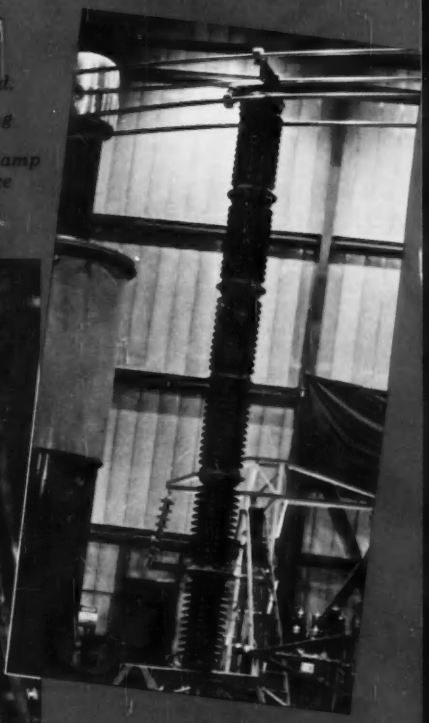




EXPERIMENTAL *grading device for shielding V-string suspension assemblies. This design was later abandoned in favor of a more simple configuration.*

2100 BIL *Station Post support (right) for four conductor bundle. Clamp assembly utilizes field surrounding bus to shield insulator—no additional grading required.*

Closeup (below) shows method of nesting bundled conductor around head of Station Post insulator. Sharp edges on clamp spacers within the bundle do not produce radio noise. Small 5 kv Posts isolate the lower conductors for test purposes.



LAPP'S PART

in Apple Grove Test Project

TRANSMISSION: Insulators, clamps and grading devices for one of the lines—designed, tested, and supplied.

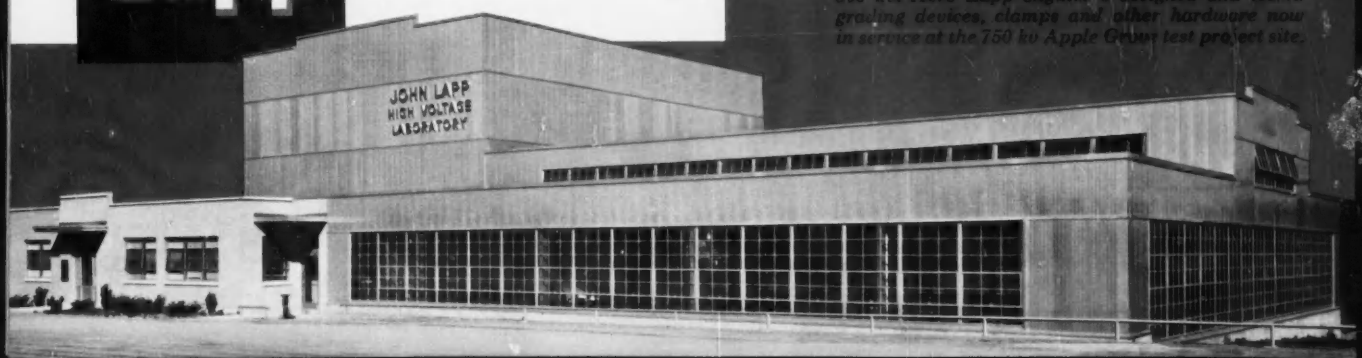
STATION: 2100 BIL Station Post insulators, bus clamps, grading devices, and transition devices for connecting rigid bus to flexible four-bundled bus—designed, tested, and supplied.

LABORATORY TESTING of bus, clamps, couplings, connectors, cable splices, dead-end clamps, T-taps, and jumper fittings.

Lapp

TRANSITION DEVICE *(above) for coupling 6" IPS tubular conductor to flexible bundled conductor, shielded with double ring assembly on left. Grading ring assembly on top of Station Post shields both the insulator and the 4-bundled flexible tap.*

INDOOR, *metal-shielded, light-proof laboratory (below) houses facilities for 60-cycle testing to 1,050,000 volts . . . impulse generator to 2,250,000 volts . . . high-current testing to 10,000 amps . . . and RIV measurement at voltages across the specimen to 600 kv. Here Lapp engineers designed and tested grading devices, clamps and other hardware now in service at the 750 kv Apple Grove test project site.*

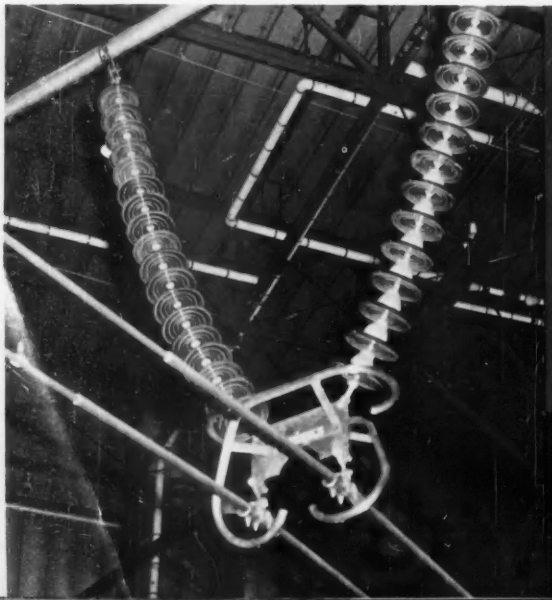


OVER 4,000 *sets of grading devices for use at 345 kv are being made and shipped from the Lapp plant for a line now under construction in New York State.*

Fruit from APPLE GROVE already being harvested in 1961

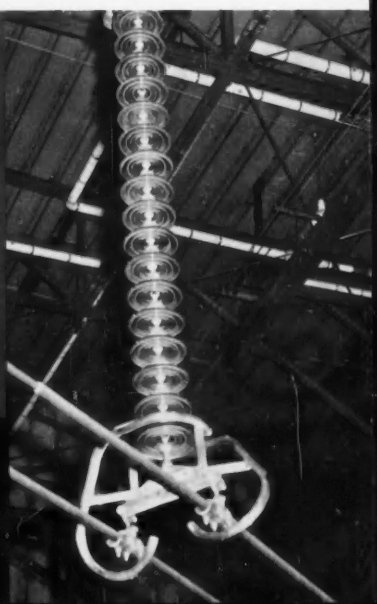
improved corona control for 345 kv transmission developed at Lapp

Exploration into new territory often results in increased knowledge in areas with which we already think we are familiar. The testing done by Lapp, by way of producing insulators, grading devices and hardware for the Apple Grove 750 kv project, has already resulted in better designs for 345 kv application. Grading devices for corona control in 345 kv transmission—developed by Lapp as a direct result of its Apple Grove work—are easier to install, more efficient and economical than any currently in use.

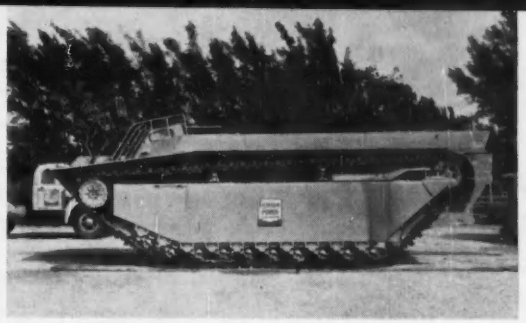


LAPP 345 kv *grading device (left) for use with V-string suspension under test in John Lapp High Voltage Laboratory.*

LAPP 345 kv *grading device (right) for single-string suspension of two-bundled conductor.*



Lapp



Utility Modifies Amphibious Vehicles For Line Maintenance

C. C. ROUSSEAU, Production Superintendent, Florida Power Corp, St. Petersburg, Fla.

Two amphibious landing vehicles, modified by Florida Power Corp's regular garage mechanics, will be used to excellent advantage for restoring service and repairing lines, during and after emergencies caused by bad storms. With these amphibious vehicles, it is expected that there will be little or no difficulty in getting men and materials to inaccessible low spots that might be submerged during, say, a hurricane or flood emergencies.

Following experiences in restoring service and rebuilding and repairing lines where the ground was under water after hurricane Donna, Florida Power purchased and modified two amphibious, 10-ton (10-ft wide, 25-ft-long) landing vehicles. These vehicles had solid-type roofs, thick glass windows and a couple of port holes over the driver's seat. Pipe railings were installed in front of the cab enclosure to ward off low branches. Two handles were installed for raising the roof which hinges back until it rests on the deck. Plans call for operating these vehicles with the roof opened when weather permits. This provides additional ventilation and makes it possible for the driver to stand up in the cab, giving him better all-round visibility. Much large armament equipment was removed from the cab interior. A sun visor and windshield wipers were also installed—when these vehicles are in the water and under way they kick up a considerable spray on the windows.

A special permit is required for moving the 10-ft-wide vehicle by tractor-trailer. However, in spite of its weight, the water transport presents no problem for hauling on a large lowboy. When the amphibious landing vehicle is being loaded, it is driven up on two layers of 10-in. × 12-in. timbers. This raises the vehicle high enough to back a lowboy under it. Then, the landing vehicle is jacked up enough for the timbers to be removed. Timbers can be placed in the landing vehicle for use in the next loading operation. Loading or unloading by this method requires 15 min.

Rooftop Solves Space Problem

A 5-million-gal oil-storage-building rooftop will, in the near future, support a new 138-kv aluminum substation to resolve a critical space arrangements problem for Consolidated Edison Co of New York, Inc's East River Switching Station.

The roof-mounted, all-aluminum substructure, weighing approximately 78,000 lb, is expected to be on-the-line in February 1962.

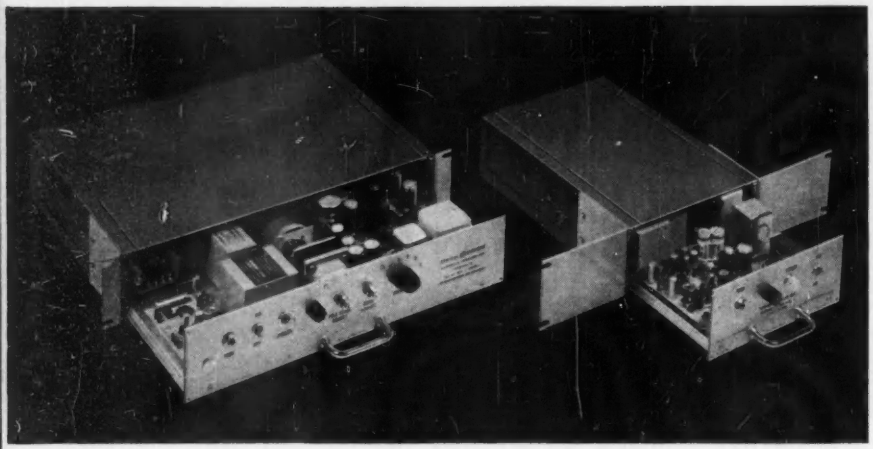
Equipment for the unique station is being shipped from General Electric's high voltage switchgear department in Philadelphia, Pa., which designed the station for Consolidated Edison.

Because of the low station-profile requirements of the installation, horizontal-break Type RC double-break air switches are being used. Con Ed ordered eight 161-kv, 1,200-amp switches and 14 161-kv, 2,000-amp group-operated disconnecting switches.

NEW GENERAL ELECTRIC

Transistorized Analog

FREQUENCY TELEMETERING OFFERS GREATER SPEED OF RESPONSE, INCREASED ACCURACY



Now available! General Electric's all-new Analog Frequency Telemetering System provides greatest possible *FLEXIBILITY* to meet utility load dispatching and industrial data transmission applications.

Universal design can be easily modified for varying applications resulting in system simplicity and flexibility. Manufacturing standardization assures quick delivery.

Optional plug-in audio-tone equipment permits transmission of data over voice or microwave channels where tone frequencies are required. Optional tone transmitter and receiver offer forty different tone frequencies available with conventional shift-type operation.

Completely transistorized system has *no* vacuum tubes. Telemeter transmitter, tone transmitter and receiver use only transistors in their circuitry. Telemeter receiver utilizes only diodes.

Compact System rack mounts—conserves valuable panel space.

Plug-in application adapters determine input range and output signals for both the transmitter and receiver. Plug-in filters and transformers select tone frequencies.

Combined accuracy of transmitter and receiver is ±0.5 percent of full span over these variations: ± 15°C temperature, ± 5 percent voltage change, ± 3 cycles frequency. A combined accuracy of ± 1 percent of full span is assured even when the transmitter is subjected to −20 to 55°C or ± 10 percent voltage change.

System stability—±0.5 percent of full span in six months plus ±0.1 percent of full span per each subsequent six months.

Quick response—system speed of response is rated 1 second for 99 percent of scale range—practically instantaneous. Such response is invaluable in applications involving load-frequency control wherein high-speed response is essential. In addition, there is no overshoot.

For utility telemetering in transmitting rapid fluctuation of electrical quantities such as watts, vars, volts and amperes . . . for fast positive transmission of industrial process data including quantities of pressure, temperature, liquid level, flow and many others . . . check into the cost saving advantages of G.E.'s new Analog Frequency System today. Your nearest G-E sales representative will be glad to provide you with additional information on this all-new low cost system. Be sure to ask for bulletin GEA-7163, or write direct to General Electric Company, Section 599-07, Schenectady 5, N. Y.

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC

N. Y. State Grid

(*Continued from page* 37)

plants from the power control center. Such an arrangement will allow control to be placed on the sources that will produce greatest economic advantage.

Under continuing study are methods for the most effective use of Niagara's pumped storage water. This Power Authority reservoir will be operated on a weekly cycle but it must be coordinated with other generation and area load requirements to obtain maximum benefits of integration.

Six Subs Unattended

Six transformer and switching stations, created for the cross-state grid, are to be unattended except for remote supervisory indication and control. Automatic controls were applied to operating functions which could be predetermined. Where concurrent judgment must be used, the controls are remotely supervised from already established, manned operating centers.

Typical of the Niagara-Mohawk 345-kv line construction is the single circuit from Utica to Albany and the two single-circuit lines from Albany to Poughkeepsie. Generally, the right-of-way for the two lines is 250 ft wide, avoiding suburban developments. Basic design, developed by Commonwealth Associates, uses lightweight waist-type steel towers with bundled conductors and restrained middle phase insulator strings. In general, tower anchors will be concrete poured into 30-in.-dia augured holes.

A special design was required for the Hudson River crossing of two 345-kv lines midway between Albany and Poughkeepsie. Three 2,000-ft spans in each circuit, one span crossing the river and one approach span on each side of the river, were included in this special design. Crossing span towers will be 310 ft high so that conductors at midspan clear the water by 174 ft. This height was necessary even though high strength conductors at higher than usual tension were used to reduce the heights of the crossing towers.

South of Poughkeepsie, the right-of-way is only 200 ft wide with one side already occupied by a double circuit 138-kv steel tower line. The

60 miles of double circuit 345-kv line in this region will be carried on conventional square base steel towers.

230-Kv Also Used

When large units of new thermal generation were added to Huntley and Dunkirk, new transmission lines were built over the existing system to bring the power into load centers in western New York state. The large number of terminals and the short distances between terminals made 230 kv economical for this transmission.

From Huntley, two 230-kv circuits were built south into Buffalo and two north to Niagara Falls. From Niagara Falls, two lines, one by Niagara Mohawk and the other by the Authority, cross the Niagara River gorge to tie into Hydro-Electric Power Commission's 230-kv system in Ontario.

At the same time in other parts of the state, other 230-kv lines were being built by Niagara Mohawk, the Power Authority, and New York State Electric & Gas. Mainly, these lines transmit the St. Lawrence power down into the state, provide another tie to Canada and reinforce the system through the southern tier of New York State.

As the 230-kv trunk circuits take over part of the bulk power transmission, they are integrated with the existing 115-kv facilities which are retained as supplementary transmission and distribution. By 1962, transformers totaling 3,200-Mva will integrate the 230 with the 115-kv systems at ten locations across the state. These are generally autotransformers of 100 to 200-Mva in-phase tap changing but not including quadrature control.

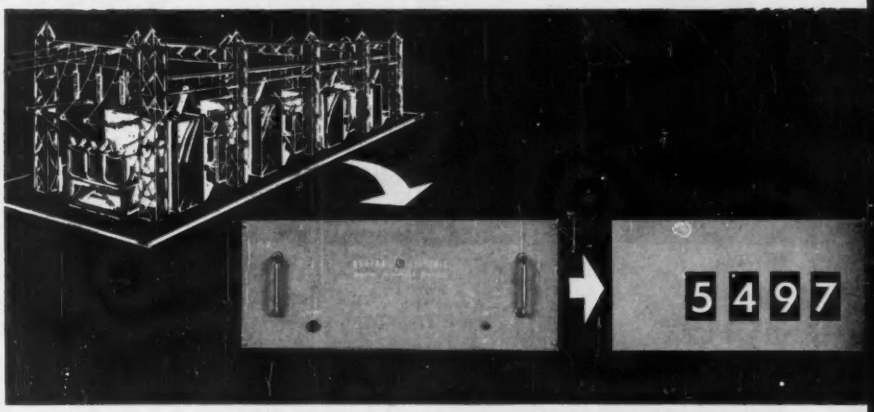
Two winding transformers added to Huntley station are the exception to the general use of autotransformers for connecting the 230-kv to lower voltages. At this station, two 125-Mva transformers connect the 230-kv to 23-kv buses which serve a major load area. Older 115 to 23-kv transformers are here retained in service to connect indirectly the 230 and 115-kv at Huntley.

The total transformation knitting together the new 230 with the latest 345-kv, and this transmission backbone with the overbuilt 115-kv part of the system, is 6,000 Mva.

NEW GENERAL ELECTRIC

Digital Telemetering

SYSTEM FOR FAST,
HIGH ACCURACY
DATA TRANSMISSION



For fastest, most accurate utility load or billing information, General Electric's all-new Digital Telemetering System brings kilowatthour information into load dispatching office over one channel, with *100 PERCENT ACCURACY*. Offers outstanding system values . . .

Flexibility: Digital telemetering signal can be time-multiplexed with an analog telemetering signal at a preset time interval, thus providing minimum channel expense and lower operating costs. Or the digital telemetering system can be used over its own isolated channel to transmit information on command. This system will also operate over any intermediate channel equipment capable of accommodating standard analog "frequency" telemetering signals.

Accuracy: Digital receiver self-checking feature permits only the readout of correct numbers.The receiver will cancel the readout if there has been an incorrect code or interference of the coded signal during transmission.

Speed: Digital transmission is in the form of long and short pulses at average rate of 10 cps. A six digit number can be telemetered in less than five seconds.

Design: System utilizes time-proved relays and stepping switches that require minimum maintenance. No tubes or transistors are used. Equipment is furnished in 19-inch rack, dust-proof cases with slide-out drawers.

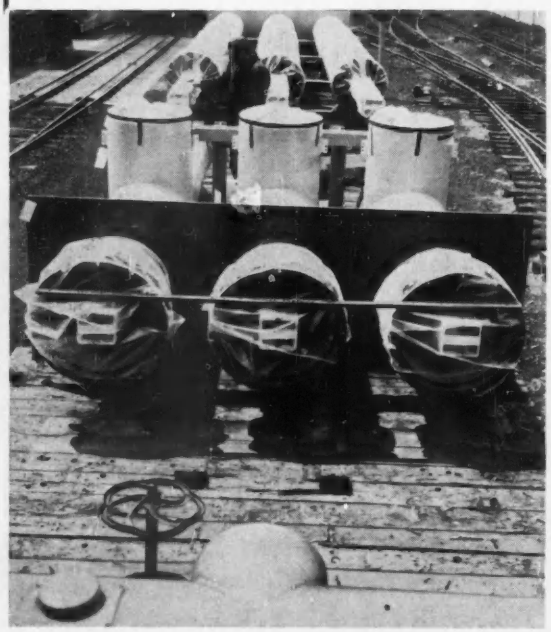
Cost: System price is usually less than the cost of comparable integrating devices which it now obsoletes.

Various read-out devices are available depending on your requirements. These include: electric typewriter, visual digital display units and tape punch equipment if you wish to use the information in a digital computer. Digital transmitters and receivers can be provided for either 4, 6 or 8 digit numbers.

For additional information on the all-new G-E Digital Telemetering System, just call your nearest General Electric sales office, ask for a copy of bulletin GEZ-3312, or write direct to General Electric Company, Section 599-07A, Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company Ltd., 940 Lansdowne Avenue, Toronto 4, Ontario.

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC



Commonwealth Ed to Receive 95-Kv BIL, 6,500-Amp Bus

The electric utility industry's first 95-kv BIL heavy-duty bus was shipped to Commonwealth Edison Co's plant at Waukegan, Ill., early last month.

Factory-assembled into the longest 3-phase bus-package shipped by industry, the bus section includes continuous conductors and stretches 32 ft to connect generator terminals and power transformer bushings.

Built by General Electric's high-voltage switchgear department, the 3-phase bus is rated 6,500 amp, 18 kv, 95 kv BIL.

This new GE all-welded bus is said to have been designed in such a way as to reduce heating in external steel to practically zero.

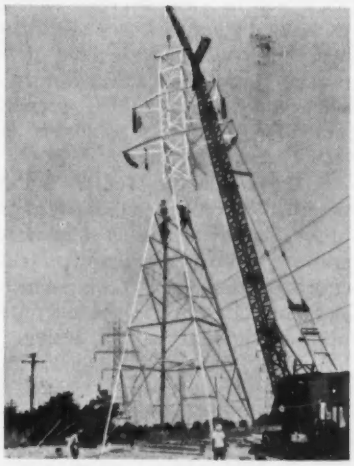
Support: SADDLE CLAMP and ARMOR RODS.
Conductor Sample: 1272 MCM 54/19 ACSR

TENSION (lbs.)	% RBS	Freq. (cps)	Amp. (in.)	Cycles (x 10^6)	STRAND BREAKAGE
10,000	22.3	26	.630	176.6	17 WIRES BROKEN

176,600,000 CYCLES
1,887 TEST HOURS
AT 22.3% TENSION

Steel Towers Capped With Aluminum

Two hundred electrical transmission tower bases have been "crowned" with aluminum structures by Niagara Mohawk Power Corp. The resulting composite aluminum-steel towers represent a new use for the light metal. With a base of steel, the aluminum tower tops—cage, crossarms, and "goathead"—were designed and fabricated by Aluminum Co of America's alcoa structural division.



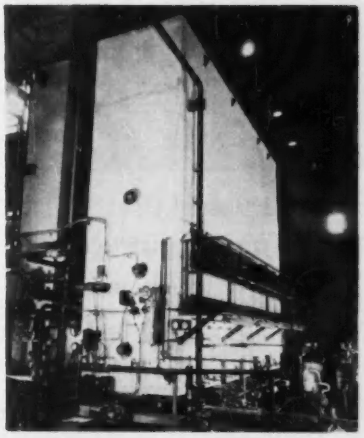
Five different designs are being installed by Niagara Mohawk on six separate double-circuit, 115-kv lines. The lines run from the Power Authority of the State of New York's new Niagara Falls power station, and interconnect with Niagara Mohawk's existing system.

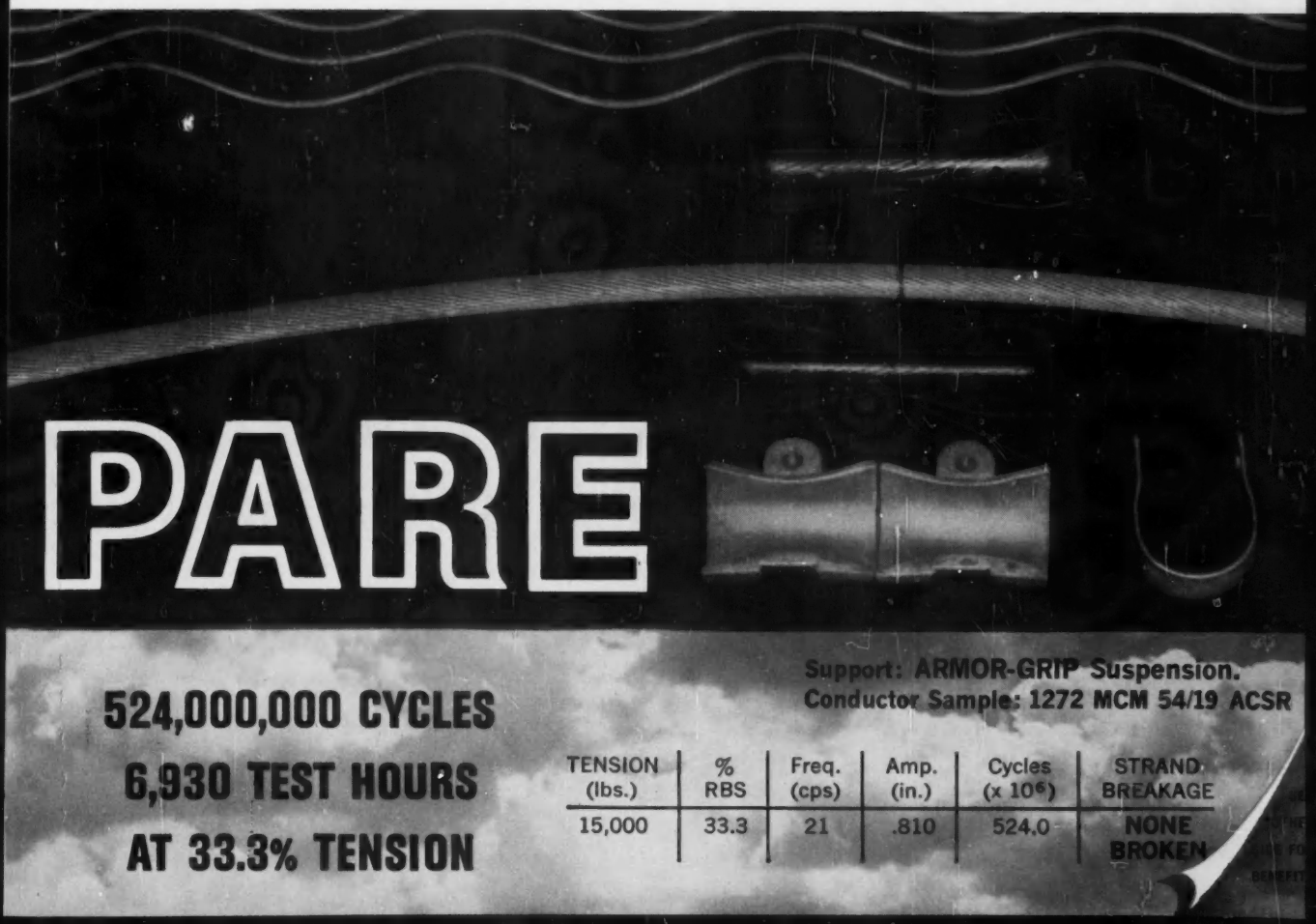
The aluminum was extruded and fabricated at Alcoa's Cressona (Pa.) works. Sub-assembly was performed by the utility at its Packard Substation.

Industrial fume contamination of the Niagara Falls area atmosphere necessitates frequent painting of steel structures, and it is reported that the utility anticipates maintenance and installation savings by utilizing aluminum structures for the upper portion of the towers.

Flash Evaporator Now Operating

A new 12-stage vertical-type flash evaporator, made by the Westinghouse Electric Corp's heat transfer department, has operated successfully for nine months at the Richmond Station of Philadelphia Electric Co. This unit is being used to produce boiler make-up water, us-




PARE
524,000,000 CYCLES
6,930 TEST HOURS
AT 33.3% TENSION
Support: ARMOR-GRIP Suspension.
Conductor Sample: 1272 MCM 54/19 ACSR
TENSION (lbs.) | % RBS | Freq. (cps) | Amp. (in.) | Cycles (x 10⁶) | STRAND BREAKAGE
15,000 | 33.3 | 21 | .810 | 524.0 | NONE BROKEN

ing filtered and softened Delaware River water. In the near future, untreated water will be supplied as make-up to the evaporator in order to determine if the cost of pre-treatment can be eliminated without affecting its performance.

Steam to operate the flash evaporator is normally supplied at 30 psia from the exhaust of a boiler-feed-pump turbine. The flash evaporator has produced its rated output of 50,000 lb per hr, with a purity of 0.16 parts per million total dissolved solids at the outlet of the distillate pump. This purity has exceeded the guarantee of 0.5 ppm in the vapor.

Reactor Vessel Uses Multi-Layer Construction

The first commercial nuclear reactor vessel incorporating multi-layer construction recently was shipped to Saxton, Pa. The vessel was manufactured for the Westinghouse Electric Corp atomic power department by the atomic and process equipment division of A. O. Smith Corp. Westinghouse will use the vessel to contain a nuclear reactor under construction for the Saxton Nuclear Experimental Corp.

The multi-layer-type construction was chosen to determine the safety, reliability, and applicability of this type of construction to future large nuclear power plants. The reactor will be used with a turbine generator which is part of the existing facility of the Pennsylvania Electric. The plant is of the closed-cycle water type and is designed to operate at power levels up to 28 tMw.

Freon Gases Developed For Transformers

A trio of halogen gases being developed by E. I. du Pont de Nemours & Co show electrical properties which should make them adaptable to transformers. Top among them is Freon C-318, octafluorocyclobutane, which at 15 psig has a dielectric strength about 30% better than that of sulphur hexafluoride, SF_6, in uniform and non-uniform fields. Freon C-318 is non-flammable and nontoxic, thermally stable and transfers heat rapidly. Its boiling point is 21.1F. A mixture of 30% Freon C-318 with 70% Freon 116, another of the trio, has a low boiling point and retains a dielectric strength approximately the same as SF_6. The third gas, Freon 115, has superior dielectric strength but is less stable than the other two. These Freons may insulate dry-type transformers, which will be smaller than present ones. They are not adaptable to circuit-breaker service.

A semiconductor, Tedlar, is expected to improve medium-voltage cable reliability because it shows less moisture absorption than present semiconducting tapes. Tedlar, which does not soil, can also be cut into sheets to serve as radiant heaters.

Another Du Pont material for improving cables is varnished Mylar. Because this thin plastic is non-hygroscopic, it is expected to be superior to varnished cambric.

What's your line tension philosophy?...LOOSE?..."CABLE"?..."CODE"?...or TIGHT?

ARMOR-GRIP TRADEMARK Suspension lets TIGHTER TENSIONS SAFELY opportunities to SUBSTANTIALLY

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Manufactured under one or more of the following U.S. Patent Numbers: 2,609,653; 2,691,865; and 2,722,393

EE
EST
ATA ON
THER SIDE

MANUFACTURERS BRIEFS

• **Pennsylvania Transformer Div** of McGraw-Edison Co will build a $2-million "pole-type" transformer manufacturing plant on a 12-acre site in Tampa Industrial Park. W. E. Kerr, president of the division, stated that the plant, a complete manufacturing facility, is being constructed specifically to serve Florida utility companies. Completion is scheduled for the end of this year.

• **American Crossarm & Conduit Co,** Chicago, has taken on national distribution of bird and pest-control chemicals made by National Bird Control Laboratories, Skokie, Ill., to utility and communications industries. Materials will be sold through Graybar Electric Co, Inc.

• **Sierra Electric Corp** has purchased, for cash, the **Square D Co's** low-voltage system for home and commercial lighting and power control. Transaction includes all manufacturing, sales rights, tooling and inventory. Manufacturing will be moved from Square D, in Cedar Rapids, Iowa, to Sierra's Gardena, Calif., plant by July 1.

• **Ralph M. Parsons Co,** Los Angeles, has purchased Anaconda-Jurden Associates, Inc, New York, formerly an engineering and industrial design subsidiary of Anaconda Co. The new Parson-Jurden Corp will operate as a subsidiary using the same location in NYC as when under Anaconda. Scope of the P-J Corp office will be broadened to include nuclear and missile engineering and construction.

• **Allis-Chalmers Mfg Co** has been awarded the contract for the final two generators for Units No. 7 and No. 8 at the US Army Corps of Engineers' Bull Shoals powerhouse on the White River, Ark. The 47,368-kva, 0.95 pf, 13.8-kv, 128.6-rpm generators are similar to the two A-C formerly supplied.

You Can Depend on

MINERALLAC®

for a complete variety of Field-Tested Insulating and Cable-Pulling

COMPOUNDS

Available in ½ Gallon, 1 Gallon, 2 Gallon, 5 Gallon Containers and 50 Gallon Drums

Minerallac has served the Electrical Industry with the finest and most dependable assortment of Insulating Compounds available, for over 67 years. Widely used, with complete satisfaction, for Cable Joints, Potheads and Terminal Bells. Eight types, for various voltage, temperature and climatic conditions. Dense, viscous and fluid consistencies. Safe, economical—outranks all others in quality.

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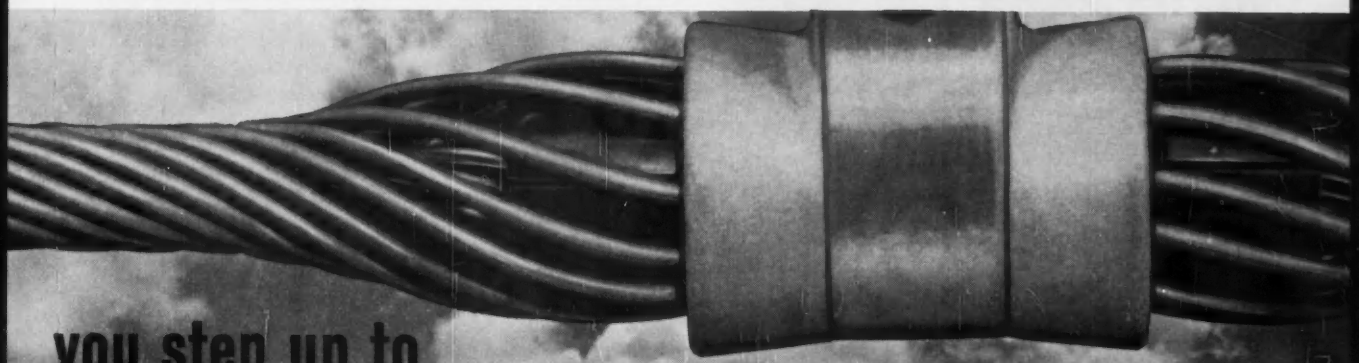


you step up to
...and opens new
REDUCE LINE COSTS:

1. FEWER STRUCTURES
2. SHORTER STRUCTURES
3. NO VIBRATION DAMPERS
4. LESS MAINTENANCE AND INSPECTION
5. FASTER CONSTRUCTION

MORE FACTS?

Extensive technical information has been compiled to assist transmission line designers in the application of some of these cost reduction factors. Please indicate which of the following information you would like to receive:

☐ "AGS DATA FOLIO" ☐ "SAFE-T-CHART FOR PLANNED LINE ECONOMIES" ☐ "DETAILED TECHNICAL INFORMATION ON 'ARMOR-GRIP' SUSPENSION" ☐ "DEVELOPING AND TESTING SUSPENSION HARDWARE FOR TRANSMISSION SYSTEMS" ☐ "PLANNED LINE PROTECTION FOR EHV" ☐ "AGS UTILITY USERS' LIST" ☐ "BROKEN WIRE ASSUMPTIONS" (AIEE Committee Report)

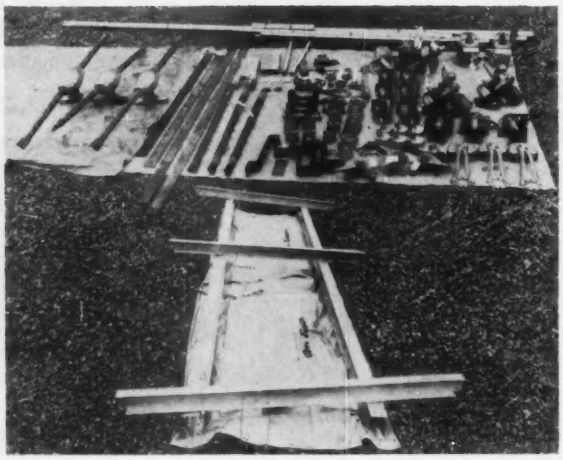


FIG 1—**TYPICAL DISCONNECT SWITCH** has many parts which must be assembled in the field at the substation

Packaged Structures Cut 138-Kv Substation Cost

T. D. REIMERS, Inside Plant Engineer, Consolidated Edison Co of New York, Inc,
J. B. NEWSOME, Senior Structural Design Engineer, Southern States Equipment Corp, Hampton, Ga.

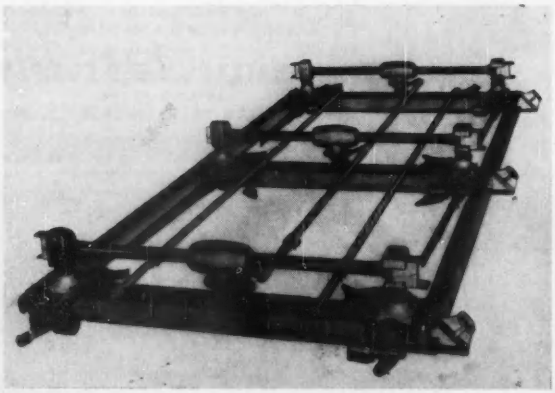


FIG 2—**PACKAGED SWITCH** and frame assembly cuts the time required for complicated assembly in field

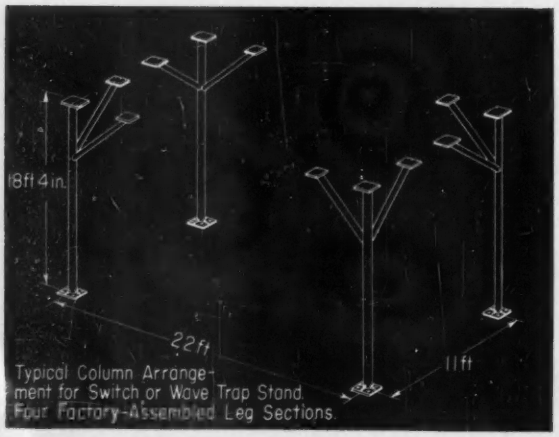


FIG 3—**LEG ASSEMBLY** is installed first; packaged switch sits on top of legs as delivered to site from factory

Factory pre-assembling of switching structures has speeded construction of Consolidated Edison's Ravenswood 138-kv switching station. Joint study by the user and manufacturer permitted pre-assembly to the limit possible for economic shipping.

The design for a packaged disconnect structure consists of a completely assembled top frame with disconnect switch base, horizontal operating rods, contacts and switch blade. These parts are all assembled and adjusted (Fig 2). Field assembly is accomplished by removing contacts and blade and re-assembling with the insulators at ground level. The upper frame and switch is then lifted to the top of the four fabricated legs and the vertical operating rods installed. Fig 3 shows the leg assemblies. Similar structure assemblies were developed for lightning arrester or bus support structure and pothead structure. All structures utilize aluminum sections to obtain minimum future maintenance and permit maximum factory assembly by welding.

The switch structures' top frame is a factory welded assembly using the aluminum switch bases as structural members. Other structures are similarly designed. Aluminum tubing with welded fittings is used for all bus work in the substation.

Bolted Galvanized Sections Facilitate Assembly

While it would be uneconomical to factory weld and subsequently galvanize assemblies of this size made of steel, they can easily be factory assembled of bolted galvanized sections.

Ravenswood Station is designed with two ring buses and connections for four generator circuits, two station light and power transformers and 14 feeder circuits. Two circuits have large phase angle regulators, and several have reactors. There are 54 disconnect switch structures as well as a variety of structures for bus supports, lightning arresters, coupling capacitors and wave traps, cable potheads and potential transformers.

this new 'echelon' lap-on-top core*...

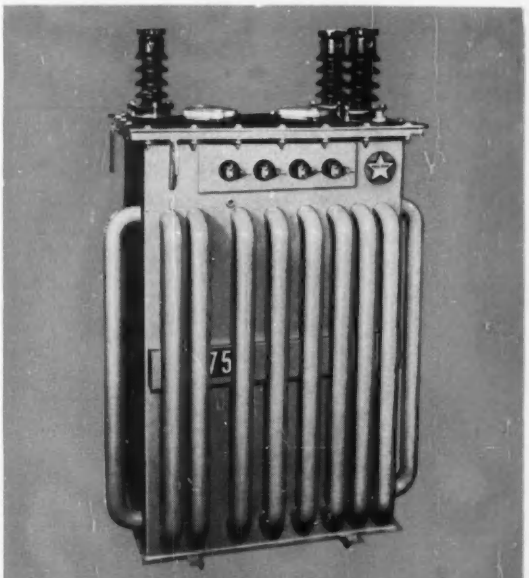
*Service-proved in single-phase Pole Star Transformers

EXAMPLE: In the case of the three-phase Pole Star Transformer shown (75 kva, 12,000△—208Y/120 volts), Pennsylvania's patented, echelon lap-on-top core *reduces exciting current by 81%*, compared with the previous design. Test results also show a 10% decrease in impedance . . . and improvements in other electrical characteristics.

Overall height has been reduced 9% . . . width, 11%. Weight reduction as a result of the improved core and new space-saving rectangular tank totals 200 pounds.

It will pay you now, more than ever before, to check Pennsylvania on three-phase distribution transformer needs—whether for pole, platform or substation installations. The new Pole Star design is available through 500 kva, 15 kv. Contact Distribution Sales, Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

McGRAW-EDISON

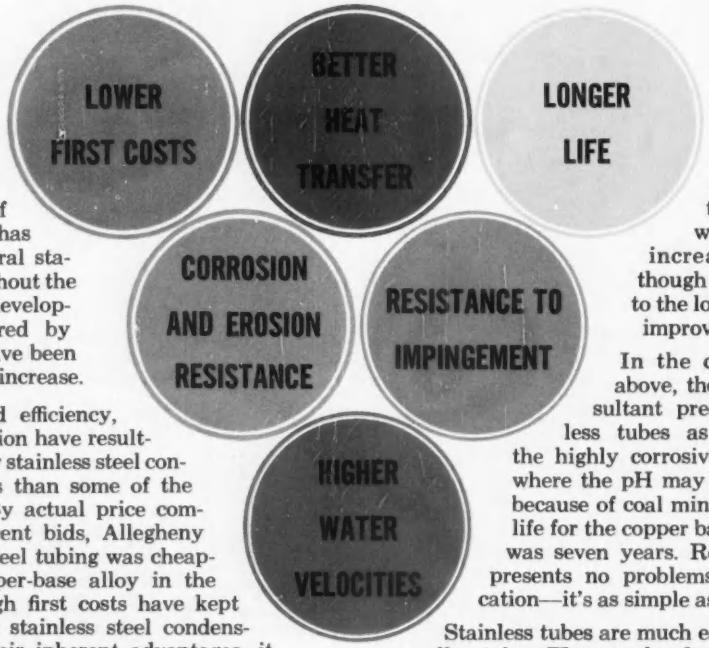


...in this new rectangular tank...

reduces overall size, weight and height of three-phase Pole Star® transformers by 10% ...and improves operating efficiency!

PENNSYLVANIA POLE STAR distribution transformers

NEW DEVELOPMENTS IN ALLEGHENY STAINLESS STEEL CONDENSER TUBES MEAN



In the last three years, over 3 million feet of stainless steel tubing has been installed in central station condensers throughout the United States. New developments, many sponsored by Allegheny Ludlum, have been responsible for this increase.

Automation, improved efficiency, and increased production have resulted in lower prices. Now stainless steel condenser tubes cost less than some of the copper alloy tubes. By actual price comparisons on some recent bids, Allegheny Type 304 Stainless Steel tubing was cheaper than a usual copper-base alloy in the same diameter. If high first costs have kept you from considering stainless steel condenser tubing with all their inherent advantages, it will pay you to re-investigate.

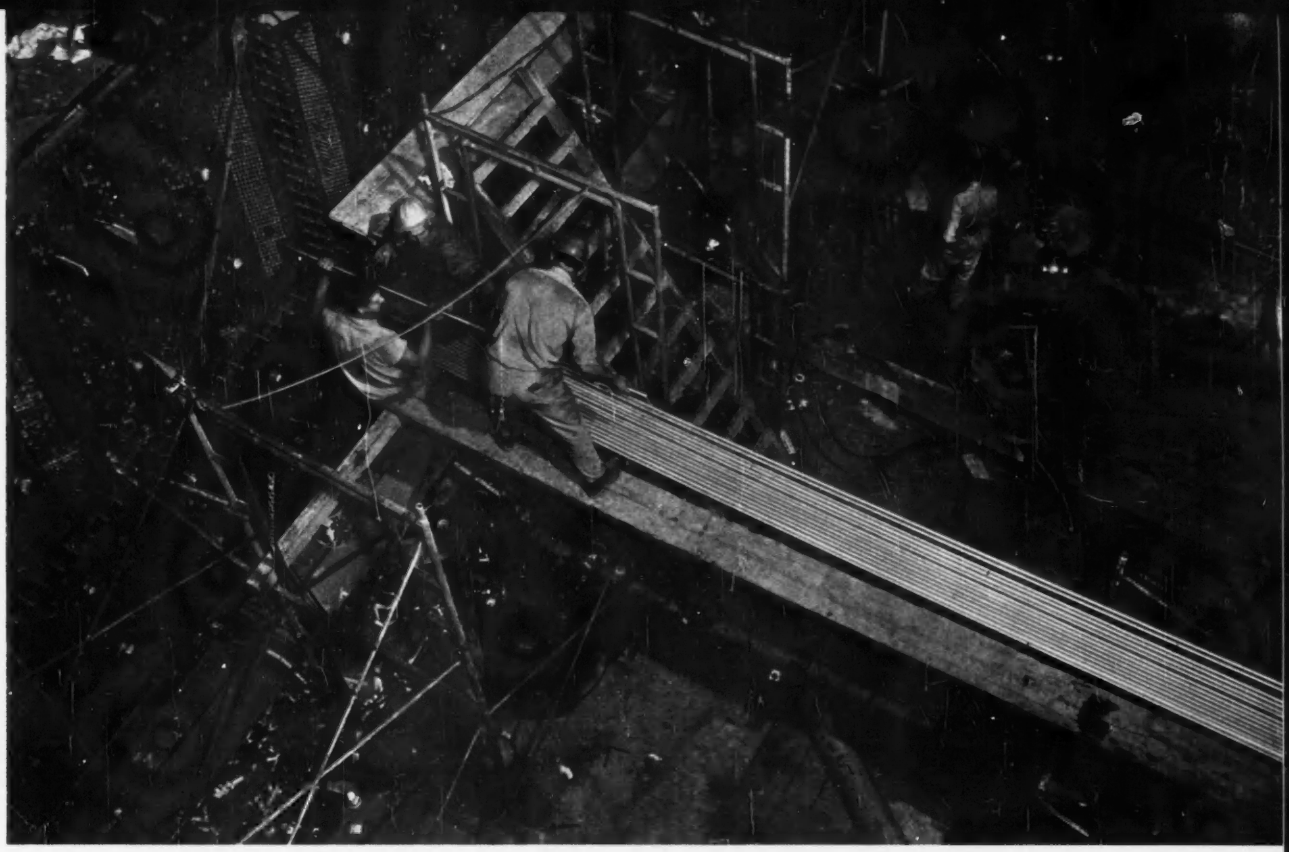
Increased operating data have shown that the in-use heat transfer rates on condenser tubes are much superior to the published data of a decade ago. Exhaustive tests made at a condenser completely re-tubed with Allegheny Type 304 Stainless Steel in May 1958 showed that the actual over-all heat rate on the turbine was improved over the 88-10-2 copper tubes previously used. Part of the answer is the thinner wall possible in the stainless tubing, 22-Bwg, compared with the 16-Bwg copper alloy tubing formerly used.

The superior strength of stainless allowed these thinner walls. In spite of the larger inside diameter, cooling water velocity through the tubes averaged ½ FPS more in stainless, although the pumping facilities were not changed. This increase in velocity, even though the ID is larger, is due to the lower flow resistance and improved interior cleanness.

In the condenser mentioned above, the utility and their consultant predict the life of stainless tubes as thirty years despite the highly corrosive river water involved where the pH may vary from three to six because of coal mine drainage. Previously, life for the copper base tubes formerly used was seven years. Re-tubing with stainless presents no problems, calls for no modification—it's as simple as re-tubing with copper.

Stainless tubes are much easier to clean than copper alloy tubes. They are harder and tougher. The mud and slime do not cling to the surface. With copper tubes, it was impossible to clean these condenser tubes without using oversize cleaning plugs which would have affected tube life. Practical cleanliness of copper tubing averages less than 60%. After re-tubing with Allegheny Stainless, one shot with nylon brushes restored cleanliness to the as-new condition.

Another major trend is the partial use of stainless tubes to resist excessive steam-side erosion. Many condensers are being specified or re-tubed with stainless tubes in the outer banks to resist blasting action or steam impingement. Generally, approximately 5% of the total tubes are specified stainless for the periphery. Even here, 22-Bwg stainless is usual where 18-Bwg or less is necessary in the copper alloys.



Retubing the air removal section of this condenser with Allegheny Stainless Tubes eliminated attack by the high ammonia content of the non-condensibles.

Another trend is the use of stainless in the air cooler or residual condenser section. Copper tubes tend to stress crack and fail because of the ammines used for water purification. Under these conditions, stainless tubes remain unaffected even under excessive build-up of ammonia in the non-condensibles.

On the horizons in heat transfer equipment design is an all stainless steel condenser that will result in an overall size reduction. With the higher strength and the less resistance to water flow of stainless tubes, water velocity through the tubes can be doubled. Erosion and corrosion can be virtually eliminated. Right now, several consulting firms are evaluating this latest development.

Stainless steel condenser tubing is welded from high quality stainless steel strip on automatic machinery. After fabrication, they are cold drawn to increase strength and improve finish. Stainless steel condenser tubes are guaranteed against preferential corrosion attack at the weld. They can be rolled or welded into the tube sheet with the same equipment and procedures as with copper alloys. At the tube sheet, stainless steel resists oxygen release. There are no galvanic problems.

The trend to stainless steel condenser tubes is growing by leaps and bounds. For more facts, details, and general information, contact the nearest Allegheny Ludlum representative or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.***

No deterioration after 17 years of operating tests in river water made highly corrosive by coal mine drainage resulted in the selection of Type 304 Allegheny Stainless for the tubes in this condenser unit.

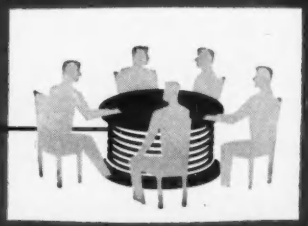
ALLEGHENY LUDLUM

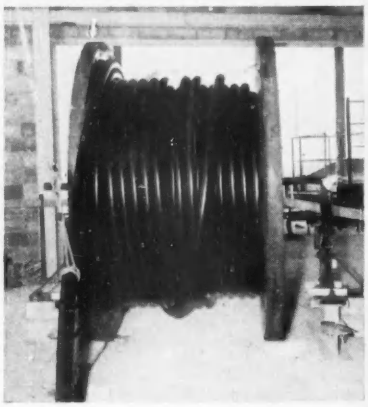
A-L products: stainless, high-temperature, electrical and tool steels; magnetic materials, and Carmet Carbides

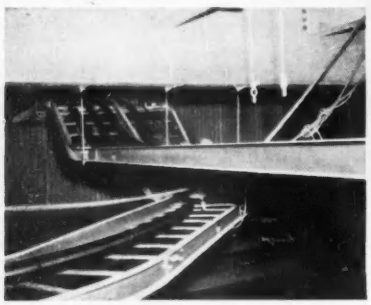
2863

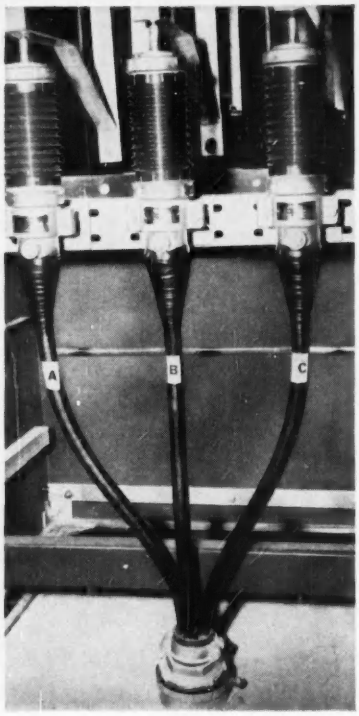
DUPONT

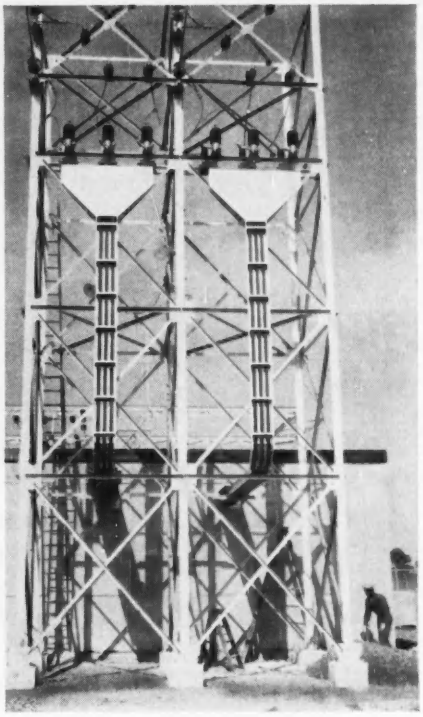
WIRE AND CABLE ROUND TABLE











Insulating and jacketing properties of ALATHON® allow innovations in 15 KV plant hookup

The pictures above were taken at a recent plant installation. They represent some construction and installation innovations made practical through the use of ALATHON polyethylene resins, as the insulation and jacket on the 15 KV cable shown.

The cables feeding from potheads in the tower to switchgear inside the building were completely pre-engineered and pre-assembled. In transit from the manufacturer, only the stiffening corners were removed to allow the bus to fold back upon itself. For installation, the corners were reassembled, and the entire feeder assembly installed in a minimum of time and expense.

Elsewhere in the plant, long lengths of the power cable were easily pulled through serpentine cable trays. For terminations, such as in the center picture, engineers designed new air-filled potheads instead of compound-filled.

To a large degree, these innovations depend upon the properties imparted by ALATHON. Because of its extremely low dielectric constant (2.28) and power factor (0.0002), insulation of ALATHON 3B, NC-10, is thoroughly reliable. Its outstanding resistance to corona, particularly at critical bend areas, is also of major importance.

As a jacketing material, high-molecular-weight ALATHON 1000, BK-30, offers trouble-free durability under a variety of severe environmental conditions. As a combination, the two compounds produce a cable of smaller dimensions with utmost reliability.

Whatever your specific cable construction, the use of ALATHON almost invariably results in a lighter, more flexible cable and one which is easier to install. A wide selection of specialized formulations of ALATHON is available to meet the electrical and environmental requirements of various installations. For more information, consult your wire and cable supplier, or write: Du Pont Company, Dept. EW 814, Room 2507A, Nemours Bldg., Wilmington 98, Del. *In Canada:* Du Pont of Canada Ltd., P.O. Box 660, Montreal, Que.

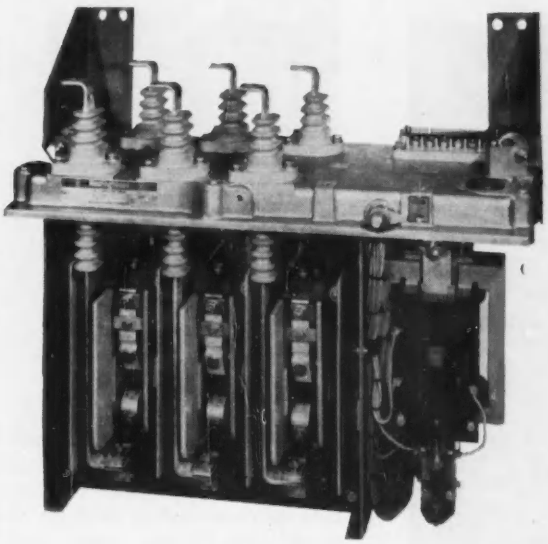
POLYCHEMICALS DEPARTMENT

ALATHON® POLYETHYLENE RESINS | **RULAN®** FLAME-RETARDANT PLASTICS | **ZYTEL®** NYLON RESINS

DUPONT REG. U.S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

New Equipment



Oil-Immersed Contactor . . .

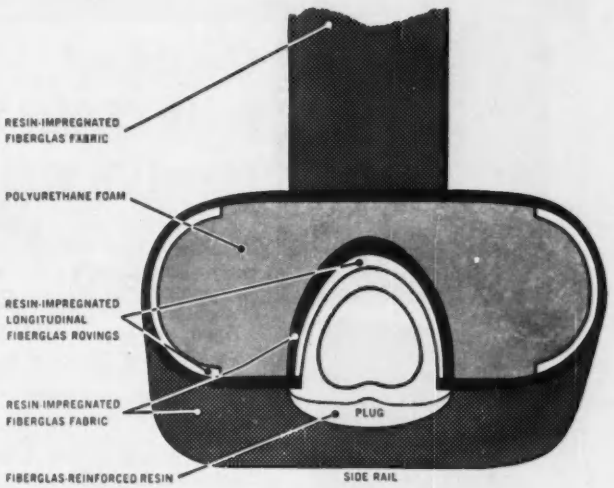
. . . starts and controls ac motors on 2.3 and 4.8-kv power systems. Three-pole Type K unit has continuous current-carrying capacity of 400 amp and interrupting capacity of 50 Mva. Contact assemblies, which operate submerged in oil, employ magnetic blowouts and single-break contacts. The copper-tungsten contact surfaces are close to tank bottom and arranged so that arc movement, during interruption, is horizontal through the oil—resulting in maximum head of oil above contacts and arc remaining well below oil surface. Unit features compact, lightweight structure and uses only 17 gal of WEMCO C oil. "Porthole" oil-level gage is located on front of tank.

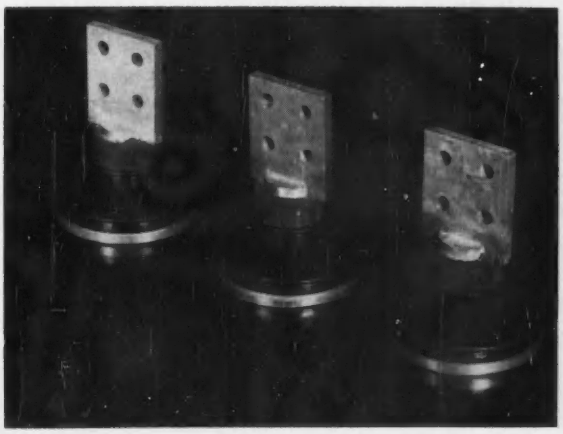
Westinghouse Electric Corp, Pittsburgh 30, Pa.

Plastic Ladder . . .

. . . supports 2,000 lb and is relatively non-conductive and moisture-resistant due to its Fiberglas-reinforced construction, with polyurethane-foam core. Side rails consist of a polyurethane-foam core, surrounded by resin-impregnated Fiberglas fabric. Resin-impregnated parallel longitudinal Fiberglas rovings are placed between the foam and fabric along both inside and outside working edges of the rails for greater strength at these stress points. Rungs are combined of polyurethane-foam core, resin-impregnated parallel longitudinal Fiberglas rovings, and resin-impregnated Fiberglas fabric. Fiberglas-reinforced resin plugs, on the outer edge of each rail, hold rungs in place and are bonded to the inner surface of the rungs by means of resin adhesive. Rubber-covered, metal feet prevent ladder from slipping.

American Allsafe Co, Inc, Buffalo 13, N. Y.





Spade Terminal . . .

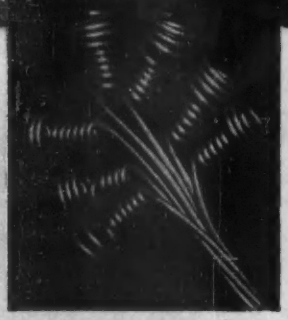
. . . provides 7-in. lower integral unit when combined with rubber bushing than conventional porcelain bushing plus connector. Of non-breakable, hard rubber which makes its own gasket, bushing is coated with neoprene for added protection against leakage and other adverse atmospheric conditions. The new terminal allows cable or direct bus connection of the secondary without the use of any intermediate connectors, for faster, easier installation. All GE submersible network protectors, 800 to 1,600 and 2,500 to 3,500 amp, will be equipped with spade terminals as standard equipment, at no increase in price.

General Electric Co, Schenectady 5, N. Y.

(*More New Equipment on page* 60)

STEEL STRAND

Mandrel Test*



Checked and Double-Checked by Laboratory Technicians

Every coil of wire used in the manufacture of *Crapo* Galvanized Steel Strand is tested and approved by trained laboratory technicians. Samples from both ends of each individual coil are subjected to a series of prescribed tests before stranding. Then, the finished strand is re-checked to make certain that it conforms in every respect to established specifications and our own high quality standards.

Thus you know when you specify *Crapo* Galvanized Strand that every precaution has been taken to assure maximum performance in the finished product.

Write for Free Booklet

"The Story Behind Crapo Galvanized Wire and Strand" illustrating and describing manufacturing techniques and testing procedures. Ask for Booklet B-59!

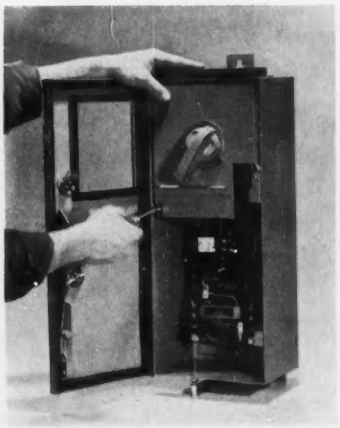
AVAILABLE IN 3 COATING WEIGHTS

FOR GUYS, MESSENGER AND OVERHEAD-GROUND WIRE

Crapo Steel Strand is available in all standard sizes and grades and in Class A, B and C galvanized coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.

*Determines ductility of wire and adherent quality of galvanizing.

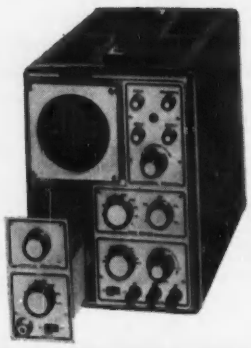
INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana



Motor Starter . . .

. . . is a combination magnetic unit with double-door, dead-front construction, designed to discourage unauthorized entry which would bring injuries to personnel and damage to plant equipment. Unit consists of a 100-Line magnetic motor starter, control transformer and branch circuit protective device (disconnect switch or circuit breaker) available in NEMA type 12 enclosure, sizes 1 and 2.

General Electric Co, Schenectady 5, N. Y.



Portable Oscillograph

. . . combines highly accurate time and voltage measurements with small size and weight. Designed by Graph Instruments, Type 310 features a flat-faced PDA tube operating at 1.5 kv with a polaroid filter for a sharply-focussed trace. Signal amplifier is a plug-in, balanced, four-stage, direct-coupled cascade unit, for optimum pulse response.

Interlab, Inc, 116 Kraft Ave, Bronxville, N. Y.

In Industrial and Commercial Installations...

WAGNER®

SUB URBAN

PAD MOUNTED TRANSFORMERS

conserve space and eliminate costly, ugly enclosures

When you plan a new distribution substation, or rework or modernize an existing system, write Wagner® Sub-Urban pad mounted transformers into your standards. They are contained in compact, tamper-proof housings that make costly, ugly, fenced enclosures unnecessary. Save space, too. They're so well ventilated they can be installed up close to the building and still be loaded to capacity. Some low shrubbery will hide them neatly ... the good looks of your buildings and landscaping are retained. People who use the buildings served by pad mounted transformers are protected from exposed hot-lines, and your crews are protected by a door over the primary compartment which lets them work on the secondary without danger from high voltage. Enclosures lock tightly to protect the equipment itself.

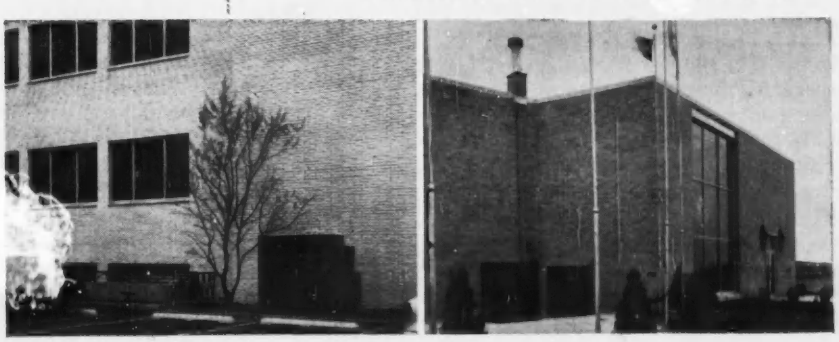
Wagner Sub-Urban pad mounted transformers are available in single-phase, 25-167 kva; three-phase, 75-750 kva. They require only routine maintenance, and when load growth makes it necessary, larger transformers can be quickly and easily installed to replace original units.

Check with your Wagner Sales Engineer. He's got complete data on Sub-Urban pad mounted transformers.. all the facts and figures that prove how easy it is to plan less costly, space-saving transformer installations.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI



This Wagner Sub-Urban transformer is installed at the Park Ridge, Illinois, executive offices of the Square D Company. It is a 500 kva, three-phase delta-connected, 4160 volt primary transformer.

These transformers serve the Dorchester Club in Dolton, Illinois. The larger transformer supplies power to refrigerate an indoor skating rink. The smaller unit powers the club's general services and all-electric kitchen.

WT61-3

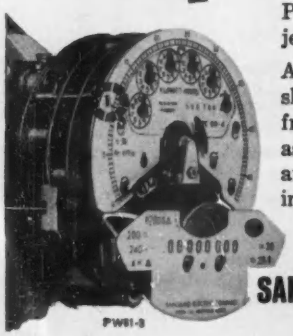
with Sangamo Dual Range Mechanical Demand Registers

Sangamo DR registers improve metering accuracy, keep pace with load growth, reduce register change-outs, and cut inventory costs by reducing the number of meters and registers you need to stock.

The Sangamo dual range (DR) mechanical register has a "flip-over" scale plate that permits rapid in-the-field range changes while assuring positive interlock between scale and range selected. It is available for singlephase and polyphase watthour meters in both universal and standard scales.

A range change is accomplished by simply loosening (not removing) six screws and reversing the scale plate. Only one gear moves, and the register does not require readjustment after the change---accuracy is always ±1% of full scale. Polished, hardened stainless steel pivots and jeweled bearings maintain the high accuracy.

And in the DR, you can rely upon the Type H slow speed, high torque motor to remain trouble free. Sangamo's gravity reset action further assures dependable, maintenance-free performance. Your Sangamo Representative has other important information about the DR.



PW81-3

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

PVC Pipe Outlasts Duct

(*Continued from page* 42)

concrete envelope, and hence without the problem of concrete entering the joints. Pulling wire brushes and cleaning attachments through the new duct line, or rodding out the new line, is not a required preparation for pulling cable.

Where a change has been made from fiber to PVC conduit in the middle of a duct run to clear obstructions, the standard tapered fiber coupling joins the two types very well. On such jobs, the joint and 3 to 4 ft of PVC conduit are encased in concrete to insure a good joint.

Although there has been no occasion for it, joining PVC to transite should not be difficult. The ends of the PVC, once heated by a blowtorch, can be flared with a large pointed mandrel.

Some utilities have reported poor experience with PVC conduit in other than network applications. Apparently, their PVC was of foreign manufacture. Tampa Electric's is American made.

More recently, PVC conduit was used by Tampa Electric on short duct runs from street manhole to customer's handhole in the sidewalk to reduce installation time on heavily traveled streets. The PVC technique is favored by municipal authorities and the public as it shortens the time traffic is blocked for street openings. For these installations, Schedule 40 PVC was used for its greater wall thickness. For the same reason, Schedule 40 PVC conduit now constitutes some main duct lines.

Cost somewhat limits the use of PVC conduit. Schedule 40 4-in. PVC conduit costs about $2 per ft delivered to Tampa, the price varying with quantity. Despite this, its use can be justified where installation time must be abbreviated and where its use solves other special problems.

As an example, when service cables to a small downtown hotel were recently replaced, the old cables could not be pulled out of the collapsed fiber conduit. As the damaged section was only 30 ft long, a trench was opened, PVC conduit laid, and the trench backfilled and ready for cable pulling in 3 hr.

Flattening of PVC pipe due to cold flow can happen, but Tampa Electric has so far escaped it.

Selling

Electronics Manufacturer To Market Dishwasher

Ling-Temco Electronics, manufacturer of electronic, missile and aircraft equipment, has gone into the appliance business. The firm's first consumer product is a dishwasher designed to fit hitherto inaccessible areas—under or above a kitchen counter or built-oven, recessed in a wall, mounted on a wall, or as a floating room divider.

The motor and controls are contained in a space 4 in. wide.

Dishes are washed and steam purified in 25 minutes. Ling-Temco claims "water spotting" has been eliminated by a built-in steam generator which produces its own distilled water and eradicates minerals.

A wave of water is propelled from a water action cylinder across the entire wash-well and is rotated from back to front for 12½ minutes. A continuous flow of water, equivalent to seven complete changes, is used. The entire washing operation is in the framework of a single cycle.

After the dishes are washed, the generator "fogs" purifying steam into the wash-well for 12½ minutes at a temperature of 212 deg.

Provision has been made for washing pots, pans and large platters through adjustable and removable racks.

A portable version is available pre-plumbed, pre-wired and preconnected and can be converted to a permanent installation.

Philadelphia Electric President Gets PR Award

R. George Rincliffe, president of Philadelphia Electric Co, has received the 1961 award of the Philadelphia Public Relations Assn for his promotional efforts on behalf of the city.

Rincliffe was honored for his company's national advertising program promoting the Port of Philadelphia. He was also cited for his role in uniting utility companies throughout the country for the development of peaceful uses of atomic power.

Now—A *unitized* power pack for *maintenance free* switchgear tripping and control!

Utilities and industrial plants can greatly increase their margin of reliability and protection for switchgear and control equipment by using C & D's *AutoCal** *unitized* Power-Pack.

Here's a dependable, high-capacity power package specifically built for tripping and control that pairs a simple, compact, C & D *AutoReg*® Silicon charger with powerful, lead-calcium grid control batteries. No adjustment or manual switching is required.

The charger is a completely automatic, constant voltage, current limiting unit. It reguiates DC output voltage within ±1% in floating range over an AC input variation of ±10%. The silicon rectifying element has no known aging characteristics. Consequently, there are no aging taps and the attendant adjustment of these is eliminated. *AutoCal* has no moving parts and it utilizes a standard 115 volt, 60-cycle, single phase outlet as a power source.

PlastiCal® batteries** have extra thick positive plates (0.266"). They provide a high one minute rate. Lead calcium grid batteries require 1/5 to 1/10 as much current to maintain a fully charged condition as do conventional batteries. Consequently, there is so little electrolysis of water occurring that the batteries need be watered only once a year.

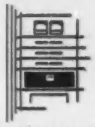
The combination of a C & D *AutoReg* charger and *PlastiCal* battery gives you self-protected charging . . . instantaneous peak power on demand . . . and long trouble free life.

Get the full details—write for Bulletin AR-102 today!

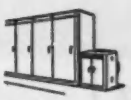
CHOICE OF MOUNTINGS

CUBICLE MOUNTING. Most popular method mounts *AutoCal* on the door of associated breaker cubicle.

WALL MOUNTING. Charger may be wall mounted near bank of indoor switchgear.



RELAY RACK MOUNTING. Charger is available with front panel for standard 19" relay rack.

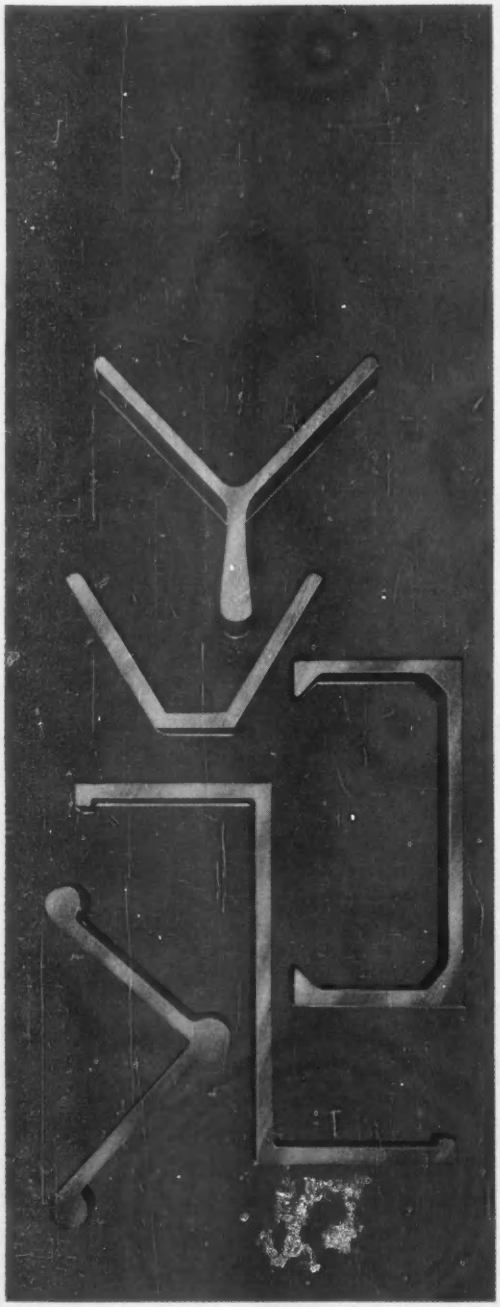


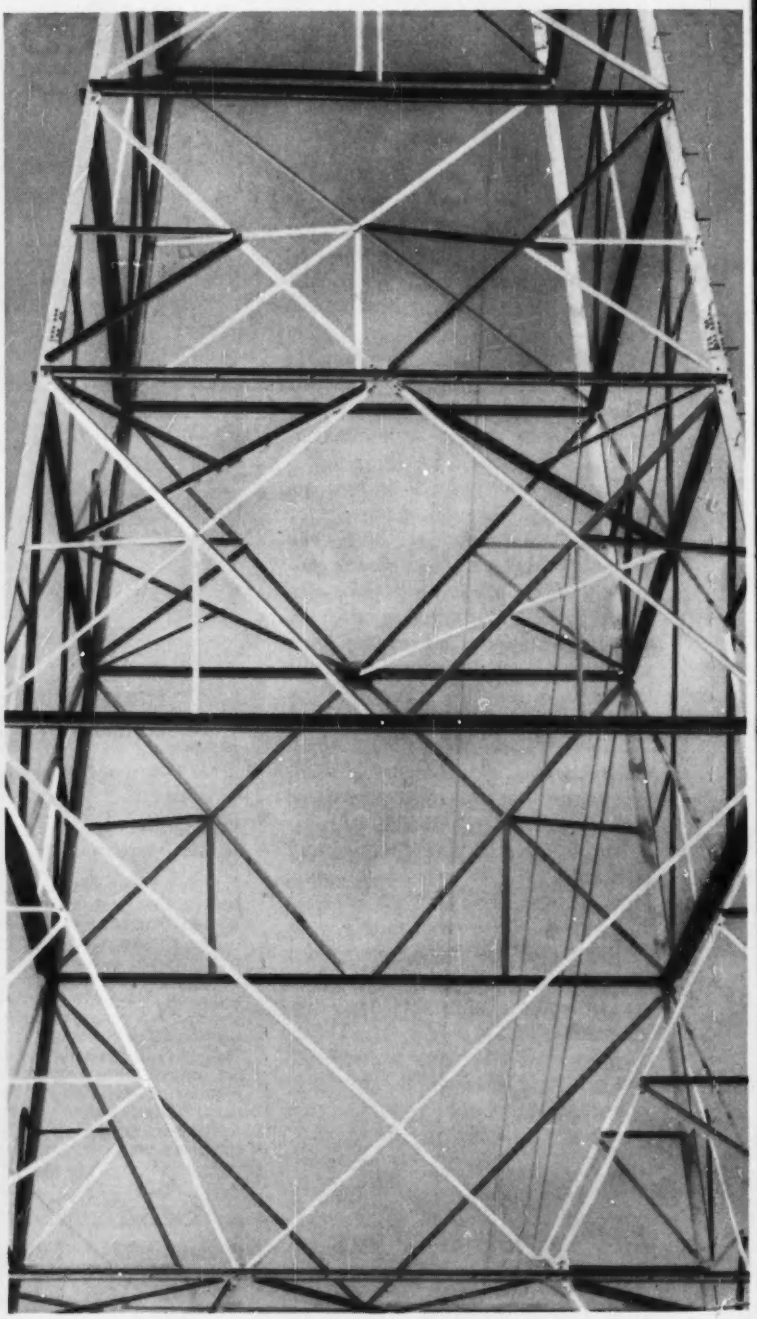
WEATHER-PROOF OUTDOOR MOUNTING. Both charger and batteries fit in a weather-proof cabinet for use with outdoor switchgear.

C&D C & D BATTERIES
of Conshohocken, Pa. . . . Attica, Ind.
DIV. THE ELECTRIC AUTOLITE CO.

Manufacturers of Slyver-Clad® industrial Batteries • PlastiCell* and PlastiCal® Batteries for Communications, Control, and Auxiliary Power • Producers of AutoReg® Silicon Chargers and AutoCal* Charger-Battery Combinations

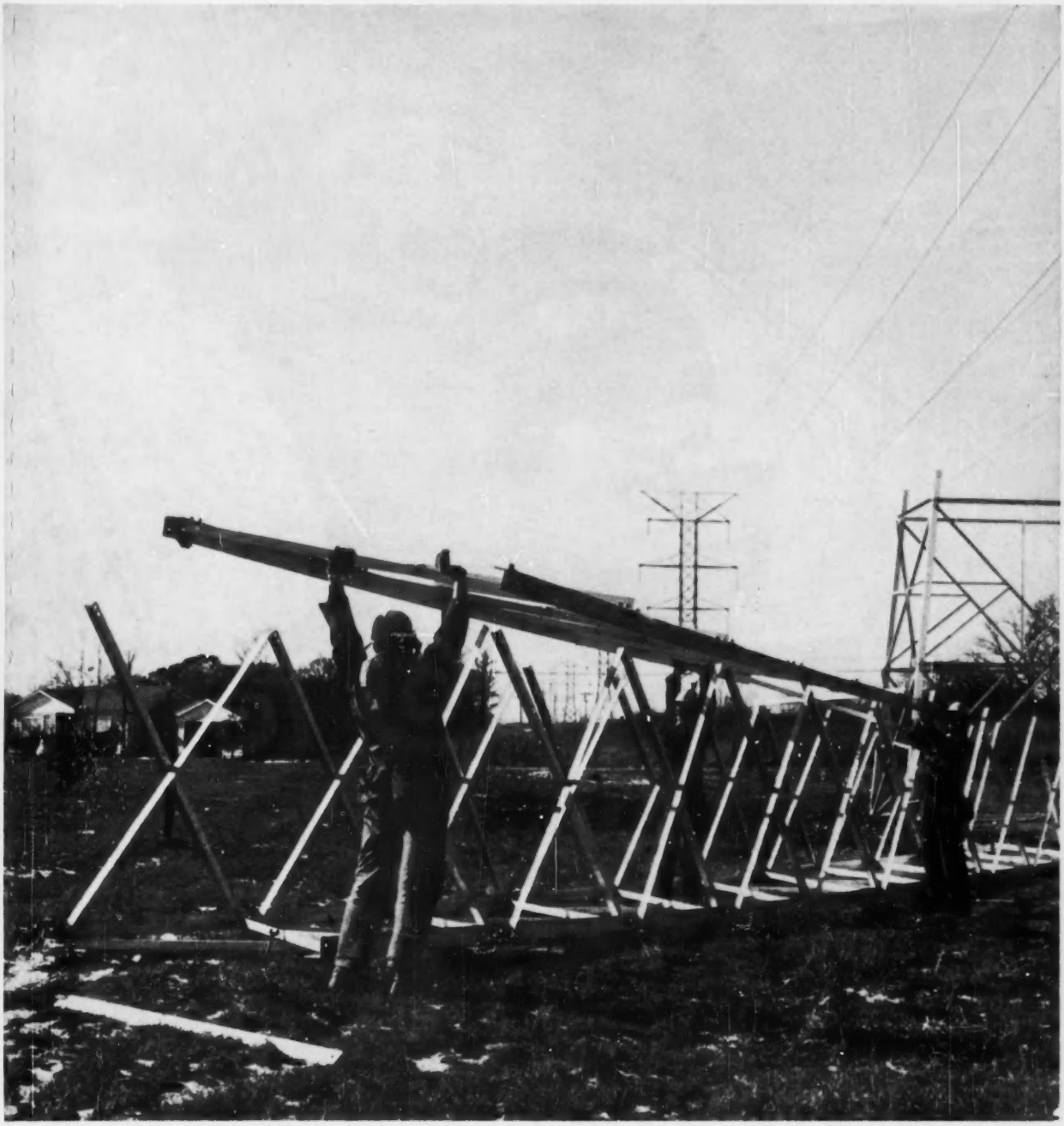
**Trademark, C & D Batteries Div. The Electric Autolite Co.*
***Designed for 25 year life*





Alcoa Structural Division designs and fabricates aluminum towers and substation structures custom-tailored to meet the job requirement exactly. Just

Write: Aluminum Company of America, Structural Division, 871-G Alcoa Building

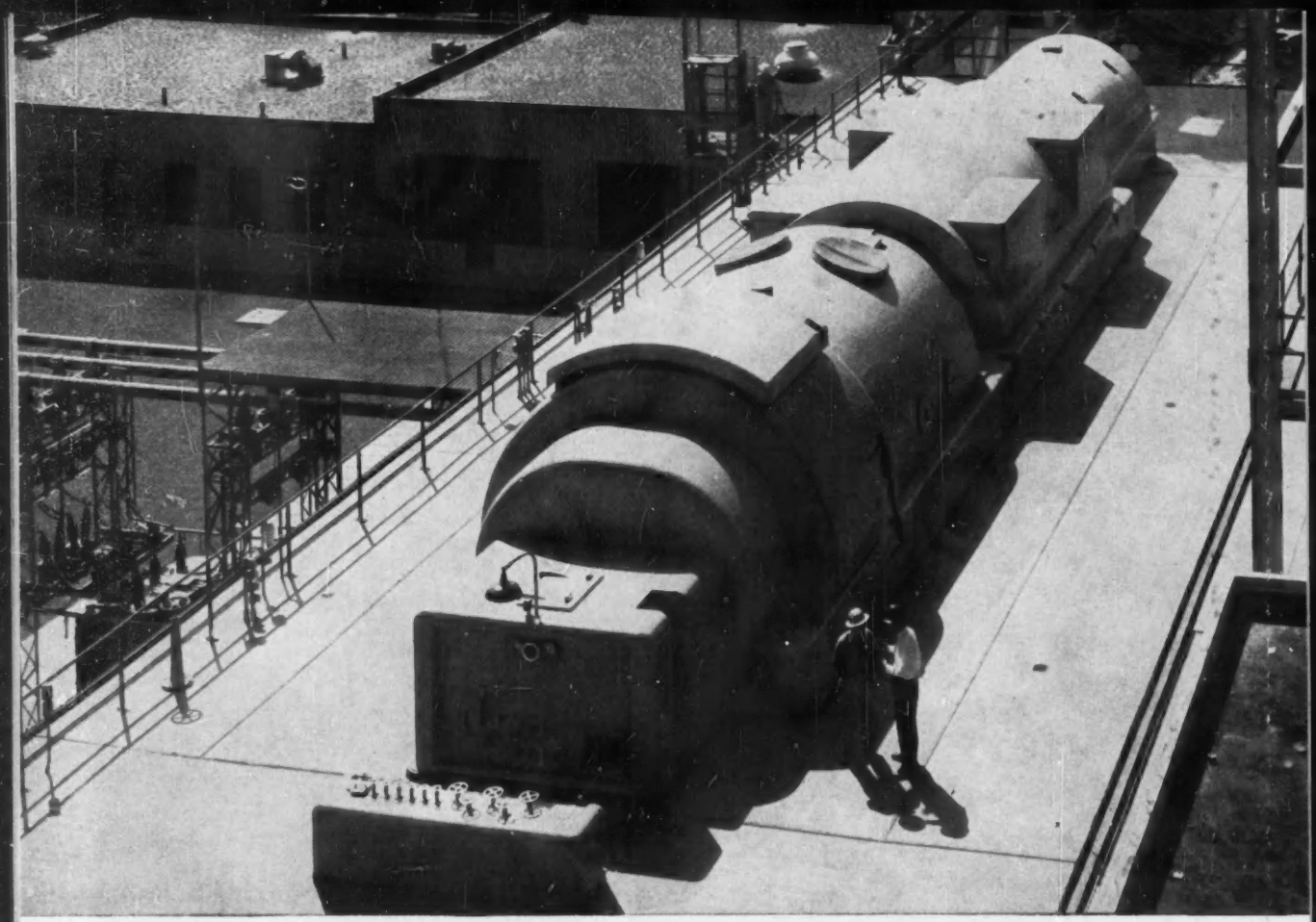


one of the many significant reasons: a broader range of "alphabetical" cross sections—L's, Y's, H's, I's, T's, O's, C's and Z's.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Pittsburgh 19, Pa.



General Electric's turbine-generator service teams make periodic visits to inspect, evaluate, and help you maintain your powermaker for optimum on-the-line performance.

Rx for keeping powermakers on-the-line

General Electric's prescription for keeping your powermaker on-the-line at optimum performance capability takes effect while your unit is being installed. It includes:

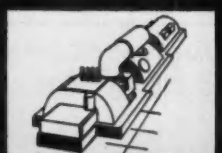
- assistance in training your operating personnel,
- periodic visits to check and discuss your unit's operation,
- assistance in planning and directing maintenance—plus prompt renewal parts procurement, and
- periodic reports on recent turbine-generator operating experience and engineering developments which may benefit your powermaker.

These are some of the "plus" services you get with a General Electric steam turbine-generator—for as long as your powermaker is on-the-line. 244-09

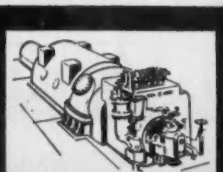
Progress Is Our Most Important Product

GENERAL ELECTRIC

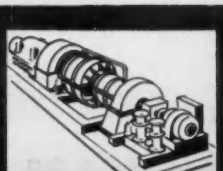
General Electric Turbine-Generators Help Keep Power Costs Low



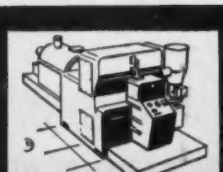
Steam turbine-generators for large blocks of power



Steam turbine-generators 100,000 kw and lower



Gas turbines for peaking, base load, combined cycles



Mechanical drive steam turbines for auxiliaries

Electrical World

JULY 3, 1961

Management Newsletter

talk to the INITIATORS

Who are the initiators? Probably you know several of them. They're the people who play the most active roles in community activities and do most of the talking when businessmen gather. They're probably on the board of the local PTA and organizers of the Little League. When the Rotarians need a guest speaker, the initiator is the fellow who knows an authority on some timely subject, and is able to secure his services. Generally, they're the most active members of a community, and usually the most influential.

Utilities have a great deal to gain by directing special attention toward them. A recent study by the Opinion Research Corp of Princeton, N. J., points out that the initiators are anxious for information. And once they become convinced of the company's viewpoint, they carry the message to the rest of the community. On the other hand, if these highly motivated people decide the company is wrong, then the public they influence will soon come to the same view.

Businessmen have always recognized that some members of the community are the most influential. Usually, they made these citizens the targets of a special public relations effort. But Opinion Research's study indicates that many companies may be shooting at the wrong targets.

The initiator, according to Opinion Research, has three basic characteristics. First, he consumes a tremendous amount of information. Second, he expresses his opinions freely and exposes associates to his ideas. Third, he has many organizational ties. He is active in a variety of groups.

What are his sources of information? Just about any source you might name. Newspapers, magazines, professional journals, books; all find their way into his

home. His favorite topics? Political and world affairs, community problems, government policies, labor matters, business conditions, and national affairs. These are the subjects he likes to discuss. And where does he discuss them? At professional gatherings, and church meetings, at the local political club and among his fellow Rotarians and Lions. At the veterans club and at business association gatherings. From this description, the initiator seems to be a choice target for the public relations executive. He's anxious to learn and anxious to inform. In addition, he moves in those channels where his opinion can count the most.

The initiator has another interesting characteristic. He tends to be a bit of an extremist. If a company does something unpopular, the majority of people will disapprove. But a far larger majority of the initiators will register their disapproval. On the other hand, when a company is clearly successful, the initiators will applaud much more loudly than the public in general. They're also more apt to carry their opinions to the polls.

	Voted in all five of the last five local and national elections
INITIATORS	62%
Income over $10,000	55%
Attended college	51%
Professional	49%
Entrepreneurial	44%

Opinion Research Corp

What about the teachers, doctors, clergymen, and other groups that are thought to be highly influential? According to Opinion Research's findings, they've had their heyday. In the 19th Century, for example, the clergy exercised a powerful role, shaping opinion in almost all sections of national life. The school teacher, too, especially on the frontier, was a recognized authority on a wide range of topics. But the forces in modern society are toward increasingly functional specialization, toward weaker communal ties, and toward rationalization. Today, a doctor's influence is likely to be confined to the medical field; and the educator's to proper teaching methods. A company which counts on these people to carry its message may find its area of influence severely limited.

It's still true that most businesses can't afford to bring their message to every individual. They must select the audience that can do them the most good. If Opinion Research's findings are correct, then this audience is no longer the newspapermen, the politicians, and the educators. Today, the company must reach the influentials in a society—the initiators. But how do you reach them?

If you are going to get your message across to them, there are two things you must keep in mind. One is that initiators don't belong to any strict economic level, nor are they engaged in any particular business. Another point to remember

is that you can influence these men. In fact, they are more anxious to hear the company's viewpoint than is the public in general.

Within the ranks of the initiators are all kinds of people—some of the staunchest friends of business institutions as well as some of the most severe critics. They are equally at home in the offices of large corporations and in meeting hall of the local labor union. They claim in their membership representatives from the professions as well as from mechanical and manual trades. We find a general trend for initiators to be among the better educated and higher income groups. But a utility which aims solely at these economic levels would fail to reach a great many of these influentials.

Initiators' Family Income

$10,000 & over	31%
$7,000-9,999	18
$5,000-6,999	27
Under $5,000	24

Initiators' Education

College complete	31%
College incomplete	22
High school complete	27
High school incomplete	12
Grade school or less	8

Opinion Research Corp

Initiators will listen to the business viewpoint. This is true regardless of their economic situation. Opinion Research found that while 68% of the general public is willing to hear the company's views on the causes of unemployment, the figure for the initiators is 83%. And while half the general public wants management to talk about union wage demands, for instance, 63% of the initiators would welcome such information.

Reaching the initiators seems to be a matter of quality. There's no particular medium they prefer. But for any given medium, the higher the quality, the more initiators a company can expect to attract. Opinion Research's study of initiators' television habits provides an interesting example.

Initiators like TV. In fact, the higher people score on Opinion Research's scale for measuring initiative, the more television they watch. The study found that 86% of those with the highest initiative spent a considerable amount of time in front of a television set. Only 57% of those who fared poorly as initiators were addicted to TV. But the initiators proved to have far different tastes in their viewing than other people.

Take an example of two companies. One sponsors a situation comedy. The other offers classical drama. Of the public in general, 57% will watch the situation comedy. Only 45% will be interested in the classical drama. But among the initiators, the figures are quite different. Here, 62% would like to watch the

drama. Only 55% would be interested in using their time to watch a situation comedy. This means that if a company's objective is to sell ideas about the corporate institution to influential people, programs with a more selective audience may well be the more economical vehicle.

This experience with television which Opinion Research uncovered probably has applications in all fields of communication. It seems likely, for instance, that initiators not only will read more, but will also select books and magazines of high quality. Thus, companies which place institutional advertising according to circulation figures or rating service reports may be missing the boat. While this method has merit for selling off the shelf consumer goods, it may not be the most economical way of selling a corporate image.

So far, we have assumed that the initiators are anonymous. You don't have to know who they are as long as you know what they want. But there are additional advantages of knowing who these people are, of being able to decide how many initiators there are in a given group of people.

Suppose, for instance, a utility wants to know the effect of a proposed rate increase. Normal sampling will give an answer. But the utility would also be interested in knowing what the initiators think of the increase. If they feel it is well justified, then this is what they will say to their many contacts and audiences. If they feel it is an open-and-shut case of exploitation, then this is what the community will be hearing. It would, therefore, be very advantageous for a company to be able to try out its proposed actions on some of the community's initiators.

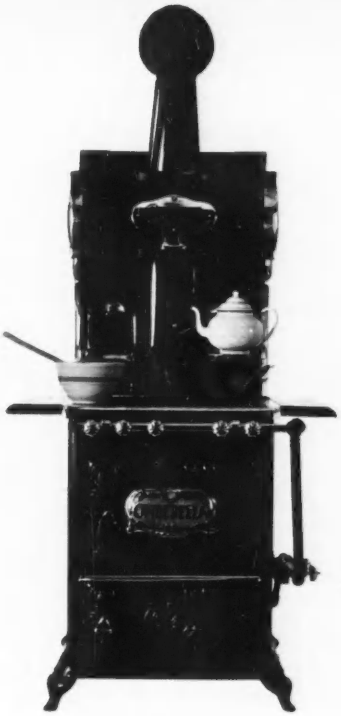
Opinion Research feels it wouldn't be too hard for a company to pick these people out of the crowd. Almost every company, Opinion Research says, is conducting some kind of research among its publics, and could, with relative simplicity, introduce the criteria for identifying the initiators in its own studies.

Opinion Research's basic tool for finding initiators was a simple three-part questionnaire. It was broken down according to the three qualities which all these people combine. The questionnaire looked for the sources of information which the person being questioned generally relied upon. It also asked the topics which he liked to discuss when he was together with other people. Finally, it asked the activities and organizations in which he was very active. Under each question were ten or more suggestions. The person was simply asked to check his favorite sources of information, or his favorite topics of conversation. Initiators tend to have more sources of information, more topics that they like to discuss, and greater involvement with civic and social associations than the public in general. They will tend to digest more newspapers than the average citizen, and read more journals. They're more willing to discuss national and civic affairs.

Once a company knows the initiators in its territory, it can set them aside as a special sample and use them to test reactions to new company policies. One company that Opinion Research talked with was concerned about possible damage to its image as a result of a strike. It was able to identify initiators by name through a recent survey, and selected this group for quick re-interviewing.

A utility company, as another example, was faced with the decision of whether to continue one of its costly programs with a "thought leader" group. The first step was to array all the several hundred groups the company now works with in terms of their likely proportion of initiators. This immediately revealed the program under consideration to be of low priority. It was easily dropped.

It seems certain, from Opinion Research's findings, that the initiators among us are a very different breed. Perhaps they hold the key to the long-standing business problem of reaching the most people for the least money. If they do, than few companies will want to miss the opportunity of talking with them.



Is your distribution system planning

Obsolete?

125

125

LL65

The distribution transformer that served the home with a gas stove and ice box is obsolete when it comes to serving today's electric home. Modern residential loads demand a transformer that can be overloaded (handle the peaks), minimize regulation problems (keep the customer's service voltage up), and operate economically at all loads (lower losses). The new Westinghouse LL-65 distribution transformer meets these requirements. It is as modern as the total electric home it is designed to serve. With the new INSULDUR insulation system, it can operate at 65°C rise and still carry 180% nameplate rating. It has a lower impedance to maintain good customer voltage; a new ratio of losses to reduce operating costs at all loads. The new LL-65 CSP has built-in lightning and thermal protection, bird and squirrel protection, new Hi-Temp WEMCO-CH insulating oil, and signal light to indicate break-even point for changeout.

Modern distribution system planning calls for a transformer design that can serve your present loads, yet be able to handle ever-increasing future load requirements—and do it economically. The Westinghouse LL-65 is that transformer. It reduces the number of changeouts required as load increases, reduces maintenance, and gives greater service life. For the transformer that will give you more performance per distribution dollar, yet is still flexible enough to meet your growing distribution demands, ask your Westinghouse representative about the LL-65. It's the transformer built today for tomorrow's loads. **You can be sure... if it's Westinghouse.**

Photography by Royal Kane, William Richards Associates, Inc. Litho in U.S.A.

J1-70957

News About People

TWOHEY

Twohey Steps Into Presidency

Edward G. Twohey has been elected president of Merrimack-Essex Electric Co, subsidiary of New England Electric System.

He succeeds Edward C. Bower who became president of Narragansett Electric Co, another New England Electric subsidiary (EW, June 26, p 136).

Twohey has been with New England Electric companies since 1925, when he joined as a student engineer. He has since held supervisory and executive positions in several New England Electric subsidiaries.

Doerr and Joyce Are Promoted at Pacific Gas & Electric

DOERR JOYCE

O. R. Doerr has been named vice president and assistant to the general manager of Pacific Gas & Electric Co, and R. W. Joyce has become vice president in charge of commercial operations.

W. D. Howell was appointed general sales manager.

Doerr, who has been vice president in charge of sales since 1948, was with Great Western Power Co when it was consolidated with PG&E in 1930.

Joyce has been manager of the commercial department since 1954. He will be responsible for all commercial, sales and customer service operations.

Minnesota P&L Makes Hatlestad VP

L. M. Hatlestad, assistant secretary and tax agent, has been elected a vice president of Minnesota Power & Light Co. His new title is vice president-administrative.

In addition to his present responsibilities, Hatlestad will assume supervision of the personnel, public information, safety and building service departments.

Hatlestad has been with Minnesota P&L since 1942.

◀ HATLESTAD

Commonwealth Services Picks Wyland to Be Vice President

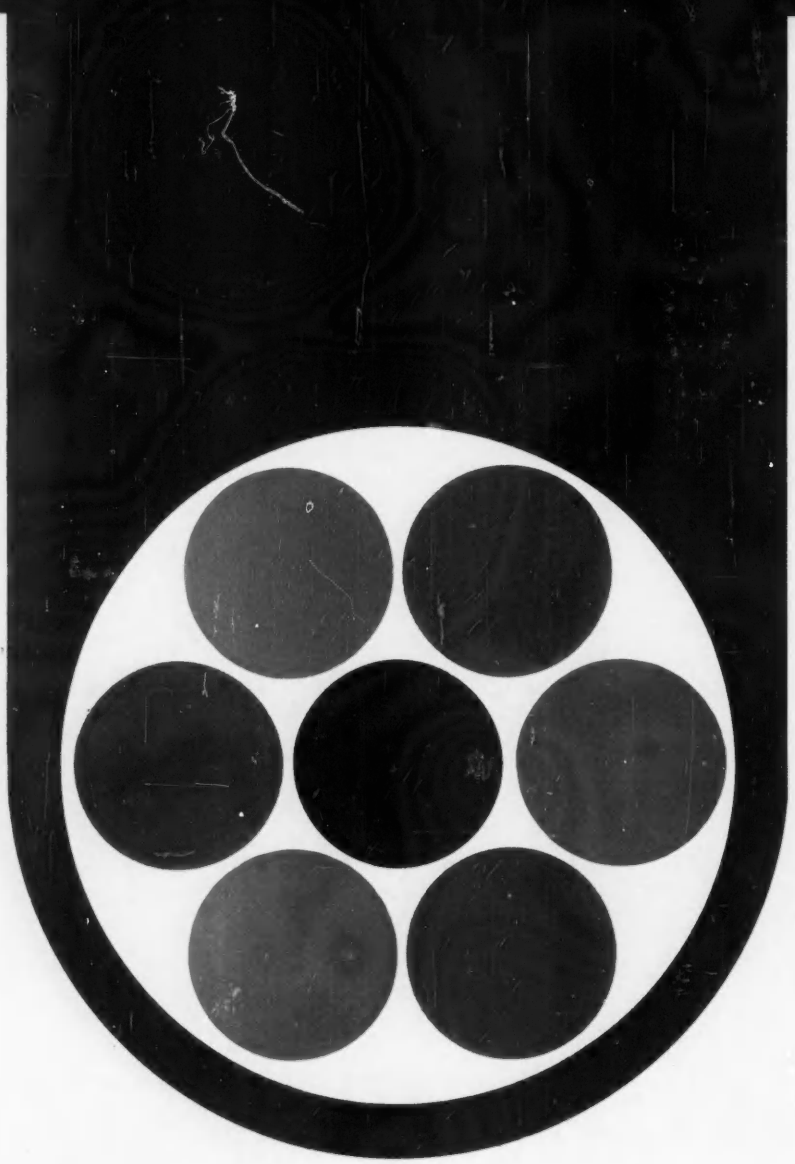
WYLAND ▶

Hugh C. Wyland has become a vice president of Commonwealth Services Inc, international management and engineering consulting firm.

Wyland is director of the Commonwealth industrial relations department, responsible for consulting work in management organization, planning, employee and labor relations.

He had his own consulting firm, Hugh Wyland Associates, prior to joining Commonwealth in 1956.

(More News About People on page 80)



NEW WAY TO EVALUATE CABLE!

"VALUE RATINGS" RELATE PERFORMANCE TO IPCEA OR COMPETITIVE STANDARDS

New Value Ratings tell at a glance the composite story of each Kaiser Wire construction—as it performed in as many as 25 specified tests. In each case a well-known standard serves as 100%:

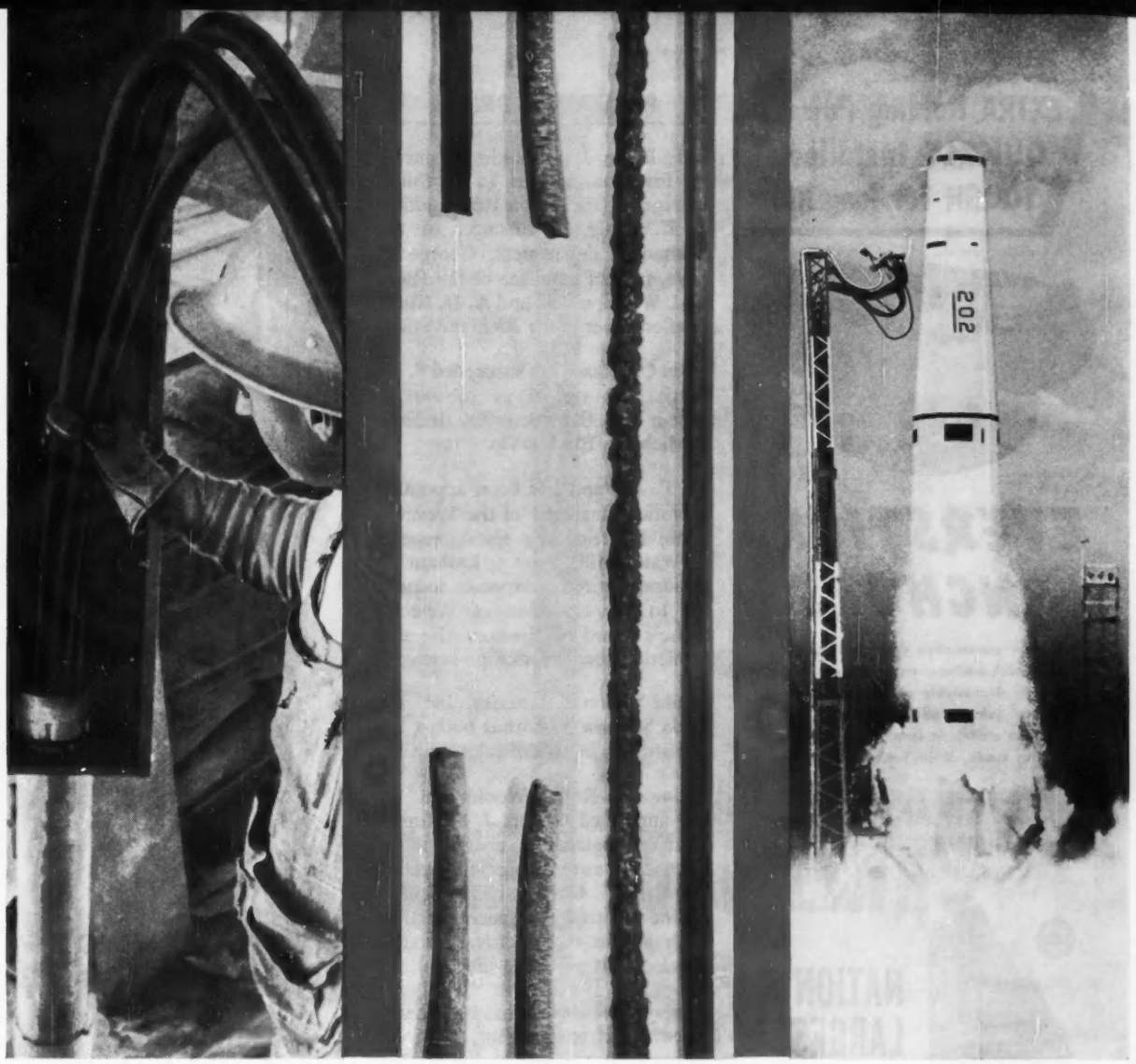
For power cable, the Value Rating standard is all IPCEA test requirements for types of insulation and jacketing specified . . . For portable cord, the standard is service-per-dollar for the least expensive cord (C.V.) as proved by life-expectancy tests.

. . . For control cable, the standard is a composite of minimum requirements for eight important insulation qualities.

Compared to these standards, Kaiser Wire constructions earn Value Ratings as large as 767%—valid proof that the spark of quality is Kaiser Wire experience.

For details and Value Rating listings, ask your Kaiser Wire Distributor for free K/W Value Rating Bulletins, or write: Kaiser Wire, Room 844a, Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

KAISER ALUMINUM & CHEMICAL CORPORATION



KAISER GRIZZLY® POWER CABLES PACK RUGGED "DOUBLE PROTECTION"

The insulation and jacketing of K/W Grizzly Spec. 831 power cables deliver more than double the protection required by IPCEA specifications. In ozone resistance, K/W Kalzone® insulation (special butyl compound used in K/W Grizzly cables) exceeds the IPCEA 3-hour minimum by *more than 70 hours*. Typical test values after aging of special K/W Neoprene 10-S jacketing exceed IPCEA minimums by wide margins. Overall comparison against IPCEA tests: 270%—the Value Rating of K/W Cable Spec. 831.

K/W GRIZZLY POWER CABLE SPEC. 831
VALUE 270% RATING

KAISER NEOPRENE 10-S CABLE JACKET RESISTS OZONE LONGEST

The picture above shows competing neoprene jackets that were stretched to twice their original lengths and exposed to .025–.030% ozone. Time: 2 hrs., 23 min. from start. Two have failed. Seven minutes later, the third competitive sample (second from right) failed. The jacket at right—special Neoprene 10-S used on K/W Grizzly power cables—was intact *18 hours later!* Kalzone® insulation of K/W Grizzly cables stood 72 hrs. in similar tests. IPCEA butyl insulation requirement is 3 hours.

K/W GRIZZLY POWER CABLE SPEC. 831
VALUE 270% RATING

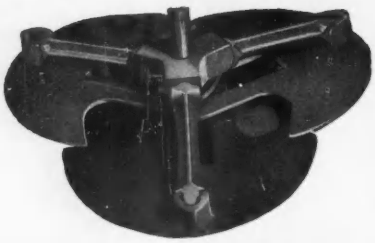
KAISER LAYTEX® CONTROL CABLE SENDS "THOR" TOWARD ITS TARGET

A single K/W Laytex control cable of 84 conductors gives Air Force "Thor" its final sendoff. Kaiser Wire has designed more than 650 such cables for missile ground controls, offering distinct advantages: Patented K/W Laytex gives greater insulation protection than any other rubber, and resists heat better than plastics. The patented Laytex-Resin construction delivers final cable diameters that are among the world's smallest. The choice of K/W insulations is the industry's widest.

K/W LAYTEX-RESIN CONTROL CABLE
VALUE 767% RATING

IN COPPER AND ALUMINUM CABLES... THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE! KAISER ALUMINUM

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life



EVERSTICK ANCHORS

For new construction and maintenance — Everstick Anchors speed up work and provide dependable anchorage on all types of jobs. Made of resiliant, rust resistant malleable iron. The toughest anchors made. Write for bulletin.

EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

NATION'S LARGEST
FEDERAL SAVINGS ASSOCIATION

pays you 4½% on savings

DIVIDENDS PAID QUARTERLY at 4½% current annual rate • World-wide savings service for 170,000 individuals, corporations and trusts in 50 states, 73 foreign countries • Same, sound management policies since 1925 • $38,000,000 reserves • Resources over $600,000,000 • Accounts insured by Federal Savings & Loan Insurance Corp. • Man and wife can have up to $30,000 in 3 fully insured $10,000 accounts (2 individual and 1 joint) • Funds received by 10th, earn from 1st • We pay air mail both ways

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FREE FINANCIAL GUIDE: "The California Story" contains experts' ideas on saving money, investing in homes, insurance, stocks. Other exciting features!

E-1

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Box 54087, Terminal Annex, Los Angeles 54, Calif.

Please send free "The California Story" and Cal Fed MAIL-SAVER® to:

Name _____

Address _____

City _____ Zone ____ State _____

☐ Funds enclosed in amount of $ _____

PERSONAL BRIEFS

H. E. Bovay Jr, consulting engineering firm, has named **L. S. Curtis** manager of the Baton Rouge office; **C. E. Craig Jr,** manager of the mechanical department; **George C. Love,** project manager of the Richland, Wash., office; and **A. H. Kintz,** chief engineer in the Richland office.

Allen C. Wilson has succeeded **S. W. Winje** who retired as substations system superintendent for Indiana & Michigan Electric Co.

M. T. Johnson has been appointed operations manager of the Westinghouse Electric Corp testing reactor at Waltz Mill, Penn. **Latham E. Osborne** retired as special consultant to the chairman of Westinghouse's board of directors. He was formerly executive vice president.

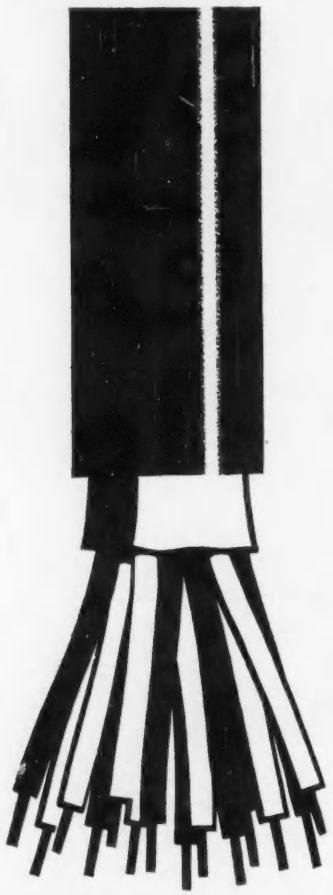
Gould-National Batteries, Inc, has made **Stephen J. Borbas** budget administrator, industrial sales division.

Thompson Ramo Wooldridge Inc has appointed **Robert J. Shafranek** as chief engineer in charge of the electrical power equipment section and **Fred H. Guth** as chief engineer of the control equipment section. Both are in the electrical product development at Tapco division.

James L. Wentworth has been designated purchasing agent, electrical products, in the purchasing section, Allis-Chalmers Manufacturing Co's West Allis works industries group.

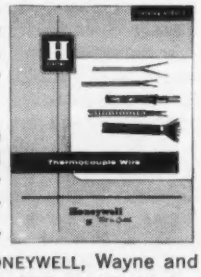
OBITUARIES

Louis A. Scofield, 66, retired senior vice president of Consolidated Edison Co of New York, Inc . . . **Thomas F. Mackesy,** 53, attorney, **Charles Edwin Marks,** 81, retired electrical engineer, both with Con Ed . . . **Robert B. Gear,** 56, purchases director for Commonwealth Edison Co . . . **Cartwright H. Goss,** 78, former field electrical superintendent, production and transmission construction department of Consumers Power Co . . . **Kenneth Laing,** 40, distribution engineer for Pacific Power & Light Co . . . **Edward C. Cahill,** 60, retired president, Radio Corp of America Service Co.



MULTIPLE-CONDUCTOR T/C EXTENSION CABLE

Available with from 4 to 48 pairs of solid-conductor temperature-compensated wires. Each wire is numbered, individual conductors are twisted into pairs, each pair is color-coded by wire type. No conduit needed. Supplied in custom and standard constructions. From this one dependable source come thousands of other accessories to help your instruments perform at their very best.



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Electric utility in large eastern city seeks experienced power plant chemist.

Applicants must have degree and a minimum of 3 to 5 years' experience. Please submit complete resume, including personal and professional background and salary requirements.

All replies held in strict confidence.

P-6910, Electrical World
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
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• POSITIONS VACANT

Electrical Engineer, about 32, with 5 years experience in the electric distribution and transmission division, particularly familiar with construction and estimating with some selling experience. Location with Ohio Electrical Line Contractor. Please furnish detail experience and qualifications. P-6844, Electrical World.

Electrical Engineer. Central Illinois utility has opening in substation design, transmission design and communications for engineer with a degree. Previous experience in these fields desirable. Salary up to $9,000. Send resume of education and experience to P-6973, Electrical World.

Three Chief Operators with Public Utility experience for 80,000 KVA Hydroelectric Plant in East Pakistan. One year contract at $1000 per month with subsistance, housing and transportation furnished. All qualified applicants will be considered without regard to race, creed, color or national origin. Send resume of experience to Utah-Pakistan Inc., 221 Pine Street, San Francisco, California.

• SELLING OPPORTUNITY AVAILABLE

Representative wanted for manufacturer of street lighting equipment, pole line specialties. States of Georgia, Washington, Oregon, North and South Dakotas, Illinois, Iowa. Full particulars. RW-6918, Electrical World.

• POSITIONS WANTED

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TRINIDAD & TOBAGO ELECTRICITY COMMISSION

PORT OF SPAIN "B" POWER STATION

CONTRACT NO. 216

P.C.R. REF. NO. 1054/1011

Tenders are invited for the supply and erection of TWO 50,000 kw Turbo Alternators and ancillary plant for the Port of Spain "B" Power Station.

Tenders are invited only from firms who are prepared to submit complete tenders for each contract.

A short precis of the extent of the works for which complete and comprehensive offers are invited may be had on application to Messrs. Preece, Cardew & Rider, 8, 10 & 12 Queen Anne's Gate, London, S.W.1.

Tender documents, which will be available from 19th June 1961 and returnable by mid-day on 11th September 1961, may be obtained from the same address on receipt of a payment by cheque for £15. O. O. in favour of Preece, Cardew & Rider. This payment will not be refunded.

At a later date offers will be invited for Auxiliary Switchgear and Cabling. Persons interested in such should NOT now apply, but await further advertisements.

The Trinidad & Tobago Electricity Commission does not bind themselves to accept the lowest of any Tender, nor will they be responsible for any costs incurred by Tenderers on making their Tender.

SUBSTATION EQUIPMENT

TRANSFORMERS

QU	KVA	MFG.	VOLTAGE
1	12000	G. E.	115,000—46,000 L. T. C.
1	10000	West.	67,000—34,500, 3 Ph. Auto.
1	7500	West.	66,000—13,800, 3 Ph.
1	7500	West.	66,000—2400/4160, 3 Ph.
1	3750	G. E.	69,300—13,200, 3 Ph.
1	3000	G. E.	69,000—4340, 3 Ph.
6	1667	West.	66,000—2300/4000
3	1250	G. E.	69,300—2400/4160
6	750	Wagner	66,000Y—13,200
4	333	West.	67,000—7200/12470Y
2	2500	Wagner	45,000—4160Y, 3 Ph.
1	5000	West.	34,500—13750/6875, 3 Ph.
1	4500	West.	33,000—2500/4330, 3 Ph.
3	3333	Penna.	34,500—6900/11950Y
2	3000	Upgf.	34,750—4160, 3 Ph.
2	1500	G. E.	34,400—2520, 3 Ph.
3	1250	A. C.	33,000—480
4	750	Wagner	33,000Y—6900
3	500	Mol.	34,500—2300/4600
3	200	A. C.	34,500—2400/7200/12470Y
2	3000	G. E.	26,400—4160Y/2400, 3 Ph.
1	3750	West.	22,900—4160Y, 3 Ph.
2	3000	G. E.	13,800—2640, 3 Ph.
1	2500	G. E.	13,800—2400, 3 Ph. Unit Sub.
3	667	G. E.	13,200—240/480
1	600	Stand.	13,200—2300, 3 Ph.
1	450	Penna.	13,200—2400, 3 Ph. Askarel
1	4500	West.	7,245—2300, 3 Ph.
1	1000	A. C.	2,400/4,160—240, 3 Ph.

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1	4600 Kw, 60 cycle, 13800 volts, Generator 6500 Hp, 25 cycle, 11000 volts, Motor—300 Rpm
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1	2000 Kw, 62½ cycle, 2300/4000 volts, Generator 2800 Hp, 25 cycle, 2300/4000v, Motor—750 Rpm

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Need Engineers?

Contact them through this

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3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3—1000 KVA G-E 34500-7200/12470Y
3—1000 KVA Wag. 34500—2400/4160Y
3— 833 KVA W-H 43800—480
3— 667 KVA G-E 13200—2400/4160Y
3— 500 KVA Penn. 13200—120/240
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA G-E 2400/4160Y—240/480
3— 333 KVA Wag. 2400—120/240
1—1500/1875 KVA Mol. 3-Ph. 40,500—4800 F/C equipped
1—1500/1875 KVA Mol. 3-Ph. 34,500—2400 F/C equipped

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5316 Hetzel St.
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47 Years' Dependable Service

Meetings Calendar

JULY

Edison Electric Institute — Industrial Relations Committee, Roosevelt Hotel, New York City, July 20.

AUGUST

Western Electronic Show & Convention—Cow Palace, San Francisco, Aug. 22-25.

American Institute of Electrical Engineers—Pacific General Meeting, Hotel Utah, Salt Lake City, Aug. 23-25.

American Society of Mechanical Engineers—International Heat Transfer Conference, University of Colorado, Boulder, Aug. 28-Sept. 1.

American Institute of Mining, Metallurgical, & Petroleum Engineers—Third Annual Semiconductor Conference, Ambassador Hotel, Los Angeles, California, Aug. 30-Sept. 1.

SEPTEMBER

Association of Illinois Electric Cooperatives—Annual Meeting, Springfield, Illinois, Sept. 6-8.

Northwest Public Power Association — Power Use Section, Annual Workshop, Pacific University, Campus, Forest Grove, Oregon, Sept. 6-8.

National Rural Electric Cooperative Association—Region IV Meeting, Columbus, Ohio, Sept. 7-8; Region V Meeting Eau Claire, Wisconsin, Sept. 11-12; Region III Meeting, Alabama, Sept. 25-26; Region I Meeting, Richmond, Virginia, Sept. 28-29.

Rocky Mountain Electrical League—Annual Fall Convention, Jackson Lake Lodge, Moran, Wyoming, Sept. 10-13.

Edison Electric Institute—AGA, Accounting Section Organization Meeting, The Netherland Hilton Hotel, Cincinnati, Ohio, Sept. 11-12; Meter and Service Committee, Hotel Leland, Springfield, Illinois, Sept. 24-27; Industrial Relations Committee, Annual Round Table Conference, Drake Hotel, Chicago, Sept. 25-27.

Engineering Management Meeting—Sponsored by AIEE, ASME, Hotel Roosevelt, New York City, Sept. 14-15.

Public Utilities Association of Virginia—43rd Annual Meeting, The Greenbrier, White Sulphur Springs, W. Virginia, Sept. 14-15.

American Institute of Electrical Engineers—Petroleum Industry Conference, Jung Hotel, New Orleans, Sept. 17-20.

• **Electric Companies Public Information Program**—1961 Workshop Conference, Brown Palace Hotel, Denver, Sept. 20-22.

• **Northwest Electric Light & Power Association**—54th Annual Meeting, Sheraton-Portland Hotel, Portland, Sept. 20-22.

• **Missouri Valley Electric Association**—Accounting Conference, Sheraton-Jefferson Hotel, St. Louis, Sept. 21-22; Sales, Rural and Home Service Conference, President Hotel, Kansas City, Sept. 27-29.

• **National Power Conference**—Sponsored by American Institute of Electrical Engineers, and American Society of Mechanical Engineers, St. Francis Hotel, San Francisco, Sept. 24-27.

• **Pennsylvania Electric Association** — Accident Prevention Committee, Bellevue Stratford, Philadelphia, Sept. 25-26; Annual Convention, Bellevue Stratford, Philadelphia, Sept. 27-28.

• **Southeastern Electric Exchange**—Accounting Section, Atlanta Biltmore Hotel, Atlanta, Sept. 28-29.

OCTOBER

• **American Gas Association** — Annual Convention, Dallas, Texas, Oct. 1-4.

• **Electric Council of New England** — Management Training Course, Bald Peak Colony Club, Melvin Villiage, N. H., Oct. 1-7; Residential Sales Workshop, Hotel Wentworth-By-The-Sea, Portsmouth, N. H., Oct. 2-3; 5th Annual Conference, Hotel Somerset, Boston, Mass., Oct. 18-20.

Electrical World's Fifth Electric Heating Conference — Sheraton-Park Hotel, Washington, D. C., Sept. 25-26.

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EHV-We're ready when you're ready!

One of Alcoa's newest conductors, 2.32 inches in diameter, is the largest ever used for overhead transmission. It is installed on the Penelec experimental 460-kv transmission line energized in October of 1960.

Cable of the same diameter, but of a slightly different design, is installed on General Electric's Project EHV (pictured below) in Pittsfield, Mass. Energized at a nominal voltage of 500 kv, this conductor is the first to be tested on this project.

Participation in such current projects is part of Alcoa's continuous preparation for the future. Historically, Alcoa has been involved in nearly all extra-high-voltage test projects.

Consequently, Alcoa has manufactured conductor for more than 2000 of the nation's 2450 commercial EHV circuit miles energized at 345 kv or higher.

Ready for EHV? We've been ready since 1913, when Alcoa pioneered ACSR to carry 220 kv. And we'll be ready any time you are.

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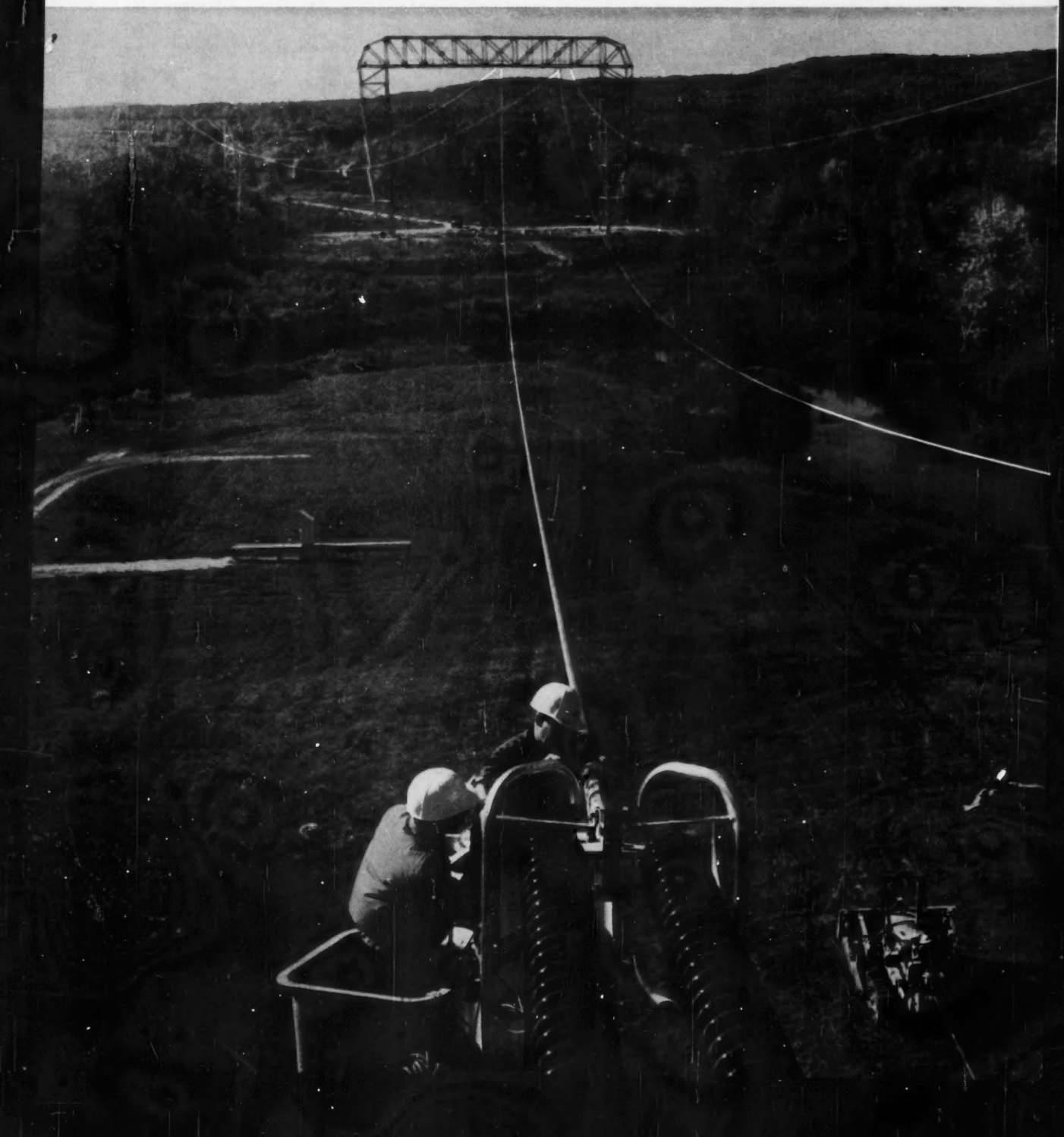
ROME CABLE
DIVISION



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Most exciting development in residential building today is the total electric home—with clean, comfortable, practical electric heat. Its growing acceptance reveals the greatest load builder for utilities in the next decade.

Help home-seekers identify the total electric homes they are looking for by using the two symbols that are recognized as marking all-electric electric-heated homes. Use the Kuhlman gold transformer on the pole that serves the home. It can be seen from a distance and is a gleaming symbol of value. Display the industry's Gold Medallion prominently on the home, too, to take advantage of the prestige of this nationally known symbol.

Use this distinctive pair to get identification and traffic for your showplace electric-heated homes. The Gold Medallion and the Kuhlman gold transformer!

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Manufacturers of transformers since 1894

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